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THE BEHAVIOR OF MAN

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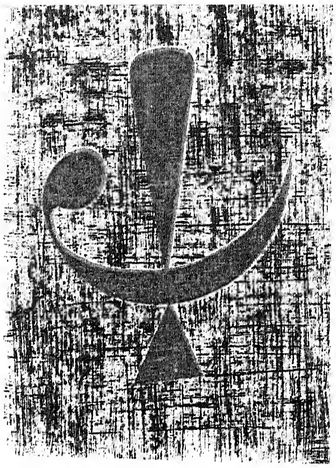

INTRODUCTION TO PSYCHOLOG

With the special assistance of Margaret F. Smith

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To Anna Kathryn

Preface

This book is the culmination of an idea about teaching—in particular about the teaching of introductory psychology. We feel that visual art and scientific writing can be related, not only to illustrate facts and to make more precise the presentation of material, but also to give meaning to abstract ideas, to stimulate the student's interest, and above all to motivate him to explore more deeply the details of the subject matter.

Although we have tried to achieve an original approach in visual presentation, our selection and treatment of material reflects our basic interest in the well-established scientific foundations of psychology. This book is written primarily about man, but does not overlook the evolutionary and bodily origins of his behavior. Our belief is that if the behavior of man is discussed in functional terms—in relation to the organization of activity in development, motivation, emotion, perception, learning, thinking, and social behavior—the student's personal interests in psychology will be strengthened and his needs in understanding behavior will be fulfilled. We have stressed man's persisting patterns of adjustment as the central theme of behavior, and have discussed the mechanisms of response and personality organization in relation to this theme.

One of our objectives in writing this textbook has been to reveal the unifying principles of a diversified field and to present with as much order and continuity as possible the scientific story of behavior. With this end in view, we have tried to write the text in a simple, straightforward manner, with few distractions. There are no footnotes in the body of the text; superscript numbers refer to bibliographical references grouped according to chapters at the back of the book. Each chapter is summarized, and a Glossary has been included. All other aids to students—suggested supplementary readings, study questions, quiz questions, and projects—are to be found in the Workbook designed to accompany the text.

From its beginnings, this book was planned and written around illustrative drawings of behavior—in experiments, in human situations, and as viewed theoretically. When it came time to prepare the final draft, we were fortunate in being joined by the artist Donald M. Anderson, who worked with us in coordinating the art with the manuscript, prepared the final drawings, and created the overall design of the book. He also guided the work of the six contributing artists, without whose assistance this large project could not have been completed. In addition to the original illustrations, we have used a number of excellent photographs made available through the kindness of many friends and colleagues.

Our work has been facilitated by many in addition to the group of artists. We have had the wholehearted support of the editorial and production staffs of Henry Holt and Company, who went to unusual lengths to implement our wishes and our needs. We are especially grateful to our editorial consultants, Donald G. Marquis and W. J. McKeachie, who read the entire manuscript in both the preliminary and final drafts. Their critical suggestions and advice have served to sharpen our thinking and improve our presentation of every major topic in the book. Our debt is great to many others: to Mrs. Janet H. Hansche, for consultation and preparation of preliminary material; to Jesse E. Gordon, for his critical assistance with some parts of the manuscript; to Irving E. Alexander, Carroll C. Pratt, Charles F. Reed, and Silvan S. Tomkins for reading parts of the manuscript and offering many valuable criticisms; to Mrs. Marjorie E. Anderson, who typed the manuscript; and to many others who are credited elsewhere in the book for providing photographs and other materials for reproduction.

Special thanks are due our wives, who aided us continually during the course of this project. But no thanks will repay in full the extraordinary help and contributions of Margaret F. Smith, whose assistance in critical editing and writing has greatly improved the final clarity of the manuscript.

Karl U. Smith
William M. Smith

October 1, 1957
Madison, Wisconsin
Princeton, New Jersey

Contents

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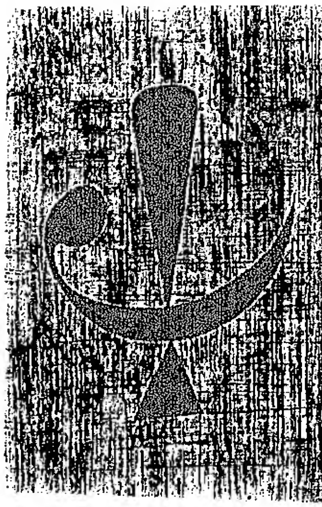


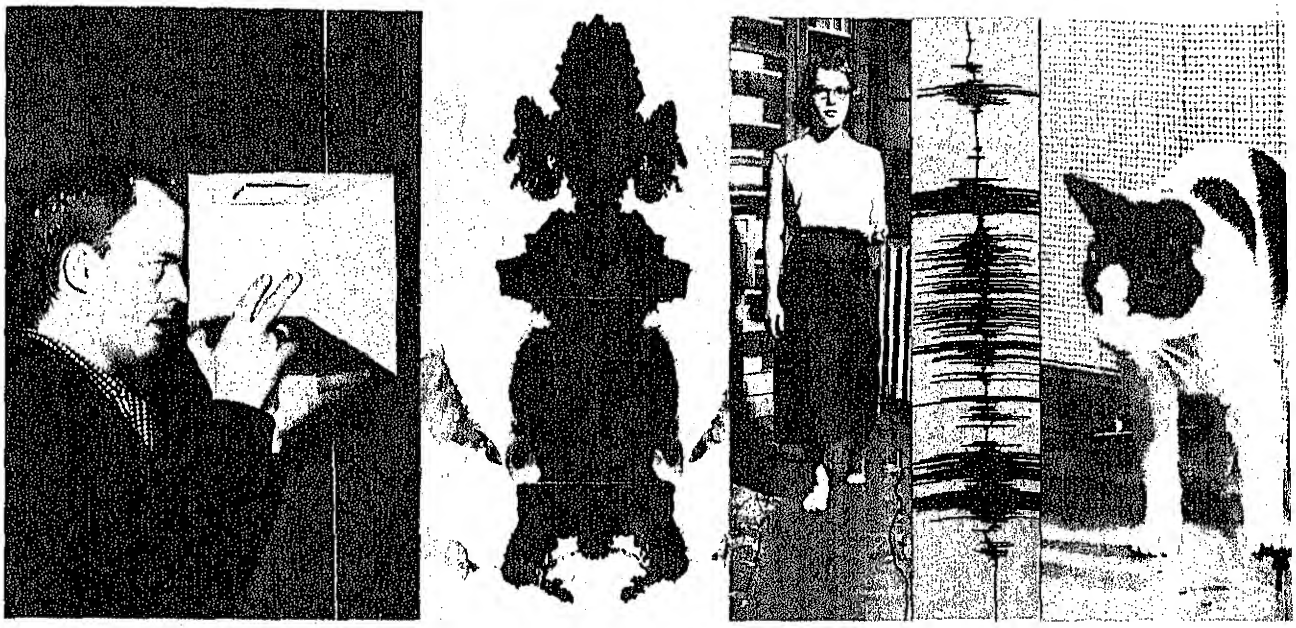
PART I. UNDERSTANDING INDIVIDUAL BEHAVIOR

Psychology is the scientific study of behavior. It is in some respects a biological science and in others a social science, for the behavior of man is the action of a biological organism in a physical and social environment. Scientific psychology is concerned both with deriving general principles of behavior and applying these principles to the understanding of individuals.

Our first step in the study of behavior is to survey the science as a whole. We shall be introduced to some of the specialized fields and uses of psychology and to the methods it uses to collect its information. We shall glance briefly at its *history, reviewing some important experimental approaches and theoretical* points of view that have contributed to present-day psychology.

Before trying to understand the detailed characteristics of behavior, it is important to get a general view of the broader aspects of behavioral organization throughout life. Individual adjustment can be described only in terms of the human situations that define it—at home, at school, at work, and in the problems and difficulties that beset the individual. The way the individual reacts to his problems, to conditions of stress, and to conflicts is a primary factor in the *development of his life pattern. The reactions of frustration are a dynamic* motivating force in individual adjustment, leading to the evolution of new habits of thinking and patterns of response.

The events of behavior are manifestations of a living system in action. An understanding of how the body works in organizing and regulating adjustive patterns of response is basic to a scientific analysis of the observable reactions of individuals. The characteristics of behavior reflect the integrated activities within the behaving organism.



CHAPTER 1. THE SCIENCE OF PSYCHOLOGY

Human behavior is many things. It is a premature baby struggling for life in an incubator, a test pilot gambling with the limits of endurance in a world beyond the speed of sound, an old Eskimo left to die because he is a burden to his tribe, a young prince learning to act like a king. It is the artist, the mathematician, the janitor, the teacher, and the politician, each applying his skill to the tasks of the times. It is the beat of the heart, the dilation of the pupil of the eye, the lifted eyebrow, the toss of the head. It is eating, drinking, loving, fighting, the building of a bridge, the writing of a sonnet. It is the singing of a hymn by a church congregation, the shrieking of a lynching mob, the deliberations of Congress, the precision of a marching band. It is the fantasies of a child, the dreams of an adolescent, the hallucinations of an alcoholic. It is all these commonplace and bizarre things, and many more which are never clearly seen. Human behavior is well known but little understood.

HUMAN BEHAVIOR

Everyone is interested in human behavior, and most of us think we know a great deal about it. And with good reason. From infancy on we learn about behavior through personal experience, by observing people, and from the communicated knowledge of others. Living in a world of people,

we inevitably learn something about how and why they behave as they do.

However, there are many gaps in our knowledge and many uncertainties. We often face problems in getting along with others that we cannot solve. We deal with personalities that we cannot understand. All too often we cannot understand ourselves. We have many questions about people and their behavior, and we look to psychology to help us find some of the answers.

Definition of Psychology. Psychology is the science of behavior. It is a broad field and uses many different methods to study the behavior of living things in the laboratory as well as in real life situations. To get some idea of the nature of this science, we must understand what a psychologist means by behavior.

When we think of behavior, we think first of the open, evident activities that we observe in other people—how they walk and talk, how they gesture, and how they perform daily tasks. We sometimes call these open, observable actions *overt* behavior. Some of the things people do are not so obvious. They get angry, or afraid, or happy, or uneasy. These emotional reactions are behavior, too, but often of a private sort that goes on inside the body and is not easily observed. There are still other forms of behavior which are usually hidden from public view. When we sit quietly and look at the sunset or listen to music, these visual and auditory perceptions are behavior. So also are our thoughts, plans, and dreams. These reactions which go on inside our bodies we call *implicit* behavior.

What do all these forms of behavior have in common? They are *responses* of a living organism to its *environment*, the adjustments an individual makes to conditions and changes in the world about him. Psychology is interested in describing all the events of behavior, the relations between them, and the factors that control them. The subject matter of psychology is as diverse and fascinating as man himself.

Psychologists are interested both in extending their scientific knowledge about the behavior of man and in applying that knowledge to human affairs. In order to get along in life, most of us must learn something about ourselves and about the behavior of others. Through the study of psychology we can learn to think creatively about our own lives and those of others, to develop new ideas about human conduct, and to discover new facts about the adjustment of people in society. Successful living is not static living. It requires the continued use of new and original ideas, especially about people. One hope in teaching psychology is to stimulate originality in dealing with the problems of human behavior in ordinary walks of life.

Psychological Events. To get some idea of the broad scope of psychology, we are going to take a look at some illustrations of actual problems as they are studied systematically in the laboratories, clinics, and agencies dealing with the science of behavior (Fig. 1.1). Most of the events seem commonplace enough. They are drawn from the everyday activities of the people around us, from aspects of emotion, learning, perception, thinking, intelligence, motor skill, language, and so on. But a scientific study of these behavioral events involves the use of special methods, special equipment, and at times a special vocabulary.

One aspect of the psychology of social behavior and personality is illustrated in the first photograph (Fig. 1.1*a*). The women are filling out an attitude scale which provides a measure of their attitudes toward their job and tells us something about their motivation in the work situation. The intent interviewer (Fig. 1.1*b*) is using the clinical method as it is applied to the study of individual personality and adjustment. Clinical procedures are also used with children to trace the development of behavior and determine individual capacities and traits. The little girl stringing beads (Fig. 1.1*c*) is performing one of the tasks in a well-known intelligence test for children.

Some of the experiments carried on in psychology require elaborate instruments which have been carefully designed to produce a certain stimulus or to measure precisely a certain response. The apparatus shown in Figure 1.1*d* is used to record brain waves. The electrodes mounted on the girl's head are connected to the recording instruments. Records of the electrical activity of the brain are studied in connection with a number of different psychological and physiological problems. In this case the brain waves, which are recorded on the paper strips seen on the table, are being used to help analyze emotional reactions. The electric apparatus in the next photograph (Fig. 1.1*e*) has been designed for use in studying problems of hearing and human engineering in the field of communication. Human engineering deals with human behavior in relation to machines which men must operate, such as radio, television, the airplane, and the automobile. In the laboratory shown here, pure tones and speech sounds can be gener-

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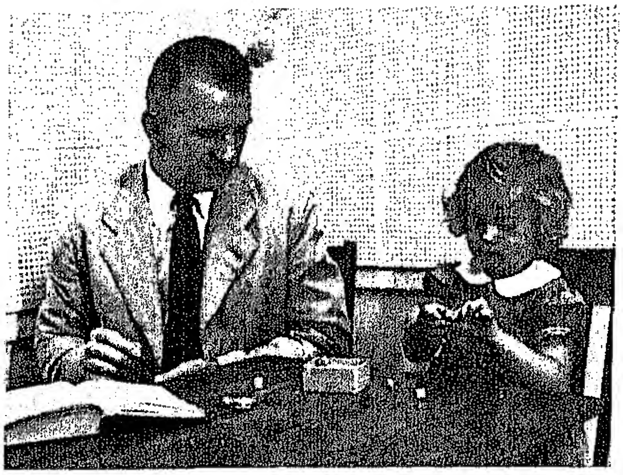
b

*Figure 1.1*a. *Employees fi attitude scale. Employers u method of measuring moti a work situation in order working conditions.* b. *A co using the methods of clinica psychology to help an indiv with a personal problem.*



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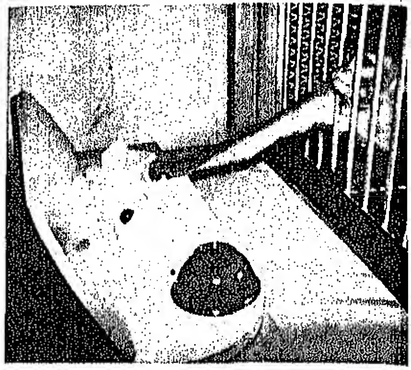

f

Figure 1.1c. The child is performing a bead-stringing task in a standard intelligence test. d. *Recording the electrical activity of the brain, or "brain waves." This is one measure of neural activity that is important in studying both normal and disturbed behavior.* e. *Elaborate equipment used to study hearing, speech, and the psychological factors in communication.* f. *The monkey is learning to discriminate objects differing in size and shape.* g. *The psychology of learning has many practical applications, including the training and rehabilitation of handicapped individuals.* h. *A reading trainer, used to measure reading speed and to improve it.*

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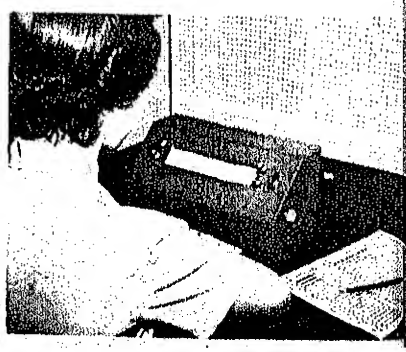

h

ated by the high-precision sound-producing and amplifying equipment. By means of such procedures, information about the perception of sound, the nature of speech and hearing, and the conditions of verbal communication is collected and analyzed.

Some of the main areas of study in psychology deal with problems of learning, training, and adjustment. In the experimental study of learning, as well as in all phases of physiological psychology, the animal laboratory is indispensable (Fig. 1.1*f*). The study of animals extends the experimental methods of psychology to include techniques which are difficult or impossible to use with human individuals; indeed, many studies of stress, emotion, learning, development, and other aspects of behavior are feasible only if animals are used as subjects.

The girl in Figure 1.1*g* is relearning the movements used in walking. It should be noted that psychological studies of learning and training range from investigations of how people acquire simple motor skills or memorize lists of words to the development of techniques of special training needed for rehabilitation of handicapped persons. Psychologists are thus concerned with the discovery of basic principles of learning and training as well as with the application of these principles to the development of the individual's personality and skills.

Psychology as a science is concerned with all the specialized patterns of response in the living individual. Reading, writing, reflex actions, motor skills, emotional expressions, thoughts, and dreams—all these are in the province of human behavior. The device shown in Figure 1.1*h* can be used to measure and develop reading skill. The reading material can be presented at different rates of speed to determine how fast the girl can read. It is also used as a training device to improve the speed of reading. The development of reading skill is, of course, a matter of serious concern at all stages of our educational system. Techniques and devices such as the one shown here are being used not only to help retarded readers but to increase reading speed of average and superior students at high school and college levels.

These various examples of psychological studies show that behavior may be investigated in many different ways and from many points of view in order to emphasize now one feature, now another, of behavior as a whole. Learning, perception, motor skill, and emotion are studied as they occur in animals and people, in children and adults, in the normal and the abnormal. Psychologists try to understand the different events of behavior as aspects of development, of social behavior, or of the physiological processes of the organism. Each field of scientific psychology develops its own methods and techniques to serve its own approaches to the problems of behavior. The knowledge gained in all of these special approaches contributes to our general understanding of psychology.

Fields of General Psychology. Because psychology deals with the behavior of different individual organisms under widely different conditions, it naturally divides itself into a number of branches or fields (Fig. 1.2). This book will survey some of these fields. The different areas of interest often overlap in subject matter, but are distinguished in their approach, methodology, and the nature of the described facts.

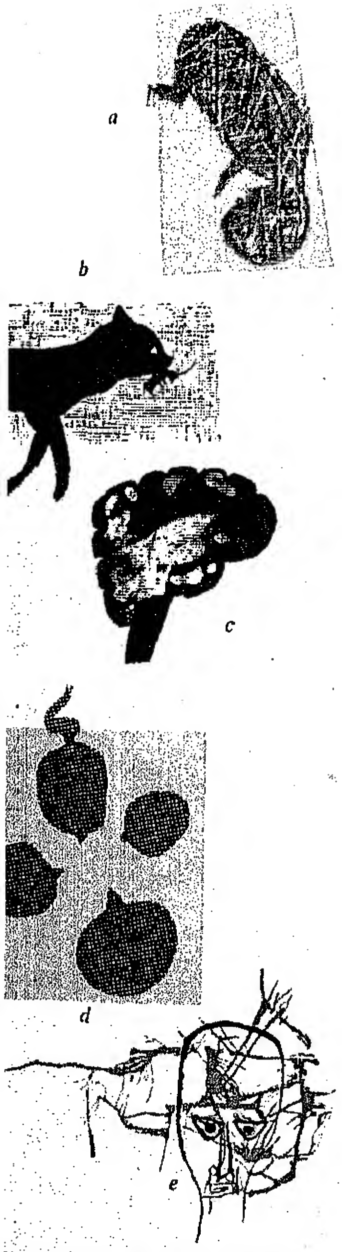

Figure 1.2. The field of general psychology draws on knowledge and research in a number of special fields. Among these are developmental or genetic psychology, a, *comparative or animal psychology,* b, *physiological psychology,* c, *social psychology,* d, *and the psychology of personality, or of individual differences,* e.

Developmental or (1) *genetic psychology* deals with the development of behavior from its first appearance in fetal life (Fig. 1.2*a*) to maturity. Developmental studies of psychological processes help us to understand those processes better; that is, studying the origins of behavior patterns in the child throws light on why both children and adults act as they do. Furthermore, the science of development underlies a sound approach to problems of child-rearing and education.

Related in some ways to genetic psychology is the field of animal or (2) *comparative psychology* (Fig. 1.2*b*). For just as the study of child behavior leads to a better understanding of adult behavior, so the study of animals contributes to our knowledge of human beings. The principle of evolution applies not only to development and change in body structure and physiological function but also to development and change in patterns and mechanisms of behavior. The study of animal behavior is, in addition, a field of interest in its own right.

A further word should be said concerning use of animals in (3) experimental psychology. Many experiments which would be dangerous or impossible with human subjects are performed with animal subjects. Animals can be subjected to strictly controlled conditions with respect to eating, drinking, mating, general activity, and they can be isolated for long periods of time. The life span of some animals is short enough to permit study of developmental changes from infancy to adulthood as well as changes in successive generations. They can be used to test the effects of drugs and unusual or abnormal forms of stimulation. Finally, they can be used to study the functions of the nervous system and other physiological systems as human subjects never can be used. Some of our most fundamental knowledge of psychological processes is based on surgical procedures and other physiological techniques performed on animal subjects.

(4) *Physiological psychology* is concerned primarily with the relations between neural events, chemical processes, and receptor and muscular activities which underlie behavior and are influenced by its course. The physiological processes of the body are a part of the adjustment of the living system to its environment. Of vital importance in the organization of behavior is the brain (Fig. 1.2*c*). It must be remembered, however, that the brain does not function alone; it is simply one part of a vastly complicated behaving organism.

Human behavior cannot be understood completely except as it occurs in relation to a social context—that is, to other individuals (Fig. 1.2*d*). (5) *Social psychology* is a field of vital significance in our introduction to the science as a whole. Our primary interest here is in group behavior and the behavior of the individual as it is defined by those groups with which he is associated.

A science of individual behavior inevitably focuses attention on the behaving organism as a whole, on the individual's integrated activities, his adjustment to the situations that confront him—in short, his personality (Fig. 1.2*e*). We are also interested in the differences among individuals and try to measure these differences. The measurement of intelligence is a field in itself. Some personalities are so different from the average—so unusual—that we are led into the study of personality dis-

Figure 1.3a. One of the best-known tools that has been developed by psychology is the standardized, objective test, which is used to measure intelligence and other human abilities, motor performances of many kinds, and aspects of individual personality. Tests are widely used in schools, industries, clinics, government agencies, and the armed forces.

a

orders or abnormalities and the methods used to help control such disorders. These areas of interest have been variously called (6) *differential psychology*, *clinical psychology*, and the *psychology of adjustment*, of *personality*, or of *behavior disorders*.

Having approached psychology from all these different points of view, we still have not quite come to grips with the central core of knowledge in this science of behavior. The field of *general psychology* deals first and last with the primary mechanisms of behavior. We shall want to know what motivates behavior—what are the drives, the hungers, thirsts, sexual motives, social and economic motives that energize human activities. We shall try to understand how emotion occurs and interacts with other behavior patterns. We need to know how we perceive the world about us—how we see, hear, taste, smell, and touch; and how we learn, think, remember, and forget. There are many dimensions of behavioral events, and psychology is interested in all of them.

The Applications of Psychology. Psychological knowledge of behavior has been put to use in many applied fields, especially in industry, in education, in government, in national defense, in the care of the mentally ill, and in welfare work. The applications of psychology are taught in such university courses as educational, clinical, or industrial psychology, and human engineering.

Some of the different kinds of psychological work which are carried on in the applied fields are shown in Figure 1.3. Perhaps the most widely used of all applied psychological procedures is the standardized objective test, which is used today in every area of human activity (Fig. 1.3*a*). Psychological tests include not only intelligence and personality tests but also performance tests of various kinds. They are used to measure specific abilities, to obtain

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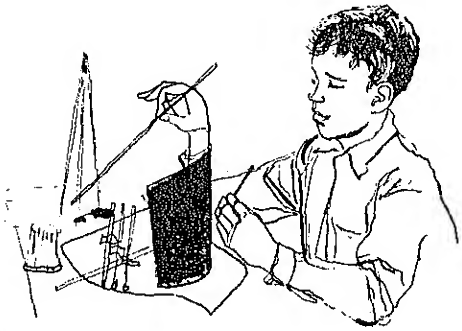

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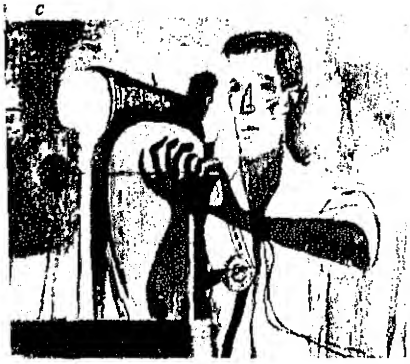

*Figure 1.3*b. *Applied techniques of learning and training are used to help individuals acquire knowledge and skill.* c. *Human engineering is the study of the human factors in work and machine operation.* d. *Advertising and marketing depend on psychological knowledge of motivation, attitudes, and communication.* e. *Behavior problems need the help of clinical psychologists.*

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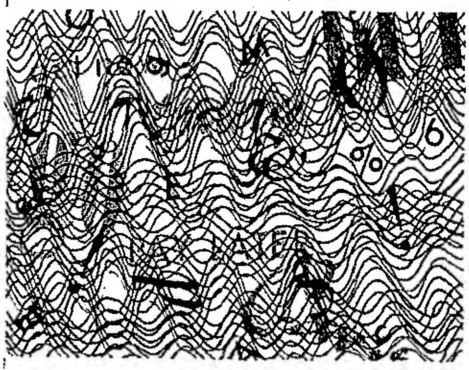

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an indication of general characteristics such as intelligence, and to secure an overall estimate of individual make-up. Some tests measure characteristics of interest, attitude, reasoning, perception, and motivation.

The psychology of education and training is one of the oldest fields of applied psychology (Fig. 1.3*b*). Originally concerned with the theory of education, educational psychology today deals with many different problems and activities, such as the education of retarded and superior children, handling children with problems and disabilities, industrial training, and development of training devices and programs for government and national defense operations.

The study of human factors in work and machine operation is known as human engineering, or ergonomics. This field is concerned with determining the optimal conditions for human work and with the human requirements and factors in the design of machines. Human engineering received great impetus during World War II and is a rapidly expanding activity in this modern world of high-speed machines and complex work organizations. Both private industry and the national armed forces present many problems in human engineering. In both of these fields efficiency and safety are prime objectives. Problems of selection and classification of workers for specific jobs require study and research, as do most of the important activities in personnel work. The operator in Figure 1.3*c* illustrates some of these problems. What is the nature of the work task? How should the operator for the job be selected? How should he be trained? How can the machine that he uses be improved for human use?

The slogans in Figure 1.3*d* represent another type of work in applied psychology—that involved in advertising, marketing, industrial relations, and political activity. An essential part of business and governmental operations is to determine and be able to predict in general how people react to events as diverse as a new bond drive and a new model of an automobile.

In all phases of human relations work the counseling psychologist is filling a vital need. He is employed in welfare work, in diagnostic and treatment work with the mentally ill, as a vocational or educational adviser in schools, and as a consultant dealing with problems of interpersonal relations in marriage, industry, or in other institutions and organizations. The counselor seen in Figure 1.3*e* is dealing with a problem common to urban society. Through interview and discussion with both the child and his parent, he is aiding in the solution of a juvenile behavior problem. To understand the child's difficulties, it is necessary to study also the activities and adjustment of the parents.

Probably the most important application of psychology is its use in the daily life of those who can profit through learning the facts and theories of human behavior. Of necessity all of us are applied psychologists, but some of us are better than others. The use of well-established information about the behavior of people will improve our understanding of our own reactions as well as the behavior of others, and will facilitate our efforts to adjust successfully to the physical and social environment. Our increased knowledge also will do much to combat the widespread dependence on bias, prejudice, and superstition.

PSYCHOLOGY AS A SCIENCE

Psychology takes its place among the sciences in its use of systematic, objective methods of observation. In common with all sciences, psychology deals with the description, causation, prediction, and control of observable events—in this case the events of behavior.

Psychology as science:

The Scientific Method. The first step in the scientific understanding of behavior is systematic, objective *description* of behavioral events. Let us use as an example an aspect of behavior which is well known to all of us: right- and left-handedness, or, more generally, *lateral dominance*. How would we describe the facts of lateral dominance?

All of us know something about this kind of behavior. We know that most people are right-handed, the others left-handed (Fig. 1.4*a*). If we stop to think about it, we realize that some people are more strongly right- or left-handed than others, and that some seem to use either hand with equal facility—that is, they are *ambidextrous*. We know that some people use the preferred hand for writing, eating, and all the common manual skills, whereas others perform some tasks with one hand and other tasks with the other. We probably know that lateral dominance extends to the use of the feet and even the eyes, but a right-*handed* person is not necessarily right-*footed* or right-*eyed*.

A psychologist who is interested in lateral dominance needs a more systematic and precise description of the facts than we have just given. To get his facts, or, as we say, to collect his data, he must describe dominance as it occurs in a great many people. To make his description

and special features of personality in an individual. The control and measurement of the dependent variables of behavior in an experiment are just as essential as the control of the independent factors or conditions under investigation.

There is a third type of control essential to experimental observation: Secondary factors must be ruled out or held constant. For example, in studying the effects of drugs we must be sure that the subjects do not respond to the effects of suggestion when they are given the drug. Therefore, we use a *control group* of subjects who are given dummy pills containing no drugs. The effects of suggestion caused by taking a pill would be the same for the experimental group (those taking the drug) and the control group. A comparison of the two groups indicates the effects of the drug. Experimental control of the secondary factors requires that the experiment be planned carefully and systematically.

Psychological experiments are often less precise than experiments in the physical sciences because of the nature of the subject matter. Behavior is a very complicated series of interrelated events which are not easy to analyze and describe. It is influenced by a great many factors or variables, many of which are difficult to measure and manipulate. At times, some of the variables in a situation are not even recognized or identified. Nevertheless, the experimental method remains the same whether we are studying the movements of men in a social field or the movements of atomic particles in a magnetic field.

The photographs in Figure 1.5 illustrate the application of the experimental method to a basic problem in human behavior. A series of experiments at the University of Innsbruck in Austria were planned to explore perceptual and other behavioral effects of inverting and reversing the visual field.[1] A number of subjects wore specially constructed glasses which inverted and reversed the visual field. The glasses fit tightly to the head so that nothing could be seen around the outside. The entire field of vision was upside down and backwards. No normal vision was permitted at any time during the days or weeks that the glasses were worn. Some animal subjects as well as human subjects were used. Figure 1.5*a* shows a chicken wearing distorting lenses.

When the subjects in these experiments first started to wear the inverting glasses, their whole world was awry. Figure 1.5*b* shows the path of a subject walking on a road, weaving from one side to the other. In Figure 1.5*c* the man on the rear seat of the motorcycle is wearing the reversing glasses. He signals with his left arm when the driver signals with his right.

Further experiments on inverted visual fields were carried out by using the specially constructed room shown in Figure 1.5*d*. Here everything is upside down except the dog, which appears to be on the "ceiling." The experimenter shown in the photograph is actually hanging on to an upside-down chair at an upside-down table.

The general results of these experiments indicated that the human subjects made a considerable adjustment to their backwards world after a period of time. They learned to adapt their actions to the world they perceived, to turn right when they should turn right, etc. Their adjustment was not complete, however. We do not know whether it ever would have been complete had the subjects gone on wearing the glasses indefinitely. The chickens in

the experiment showed practically no adjustment at all.

These experiments demonstrate one of the critical aspects of the experimental method—namely, that experiments which are carried out under controlled, systematic conditions are subject to *repetition*. Thus the observed facts can be checked and verified. The Innsbruck studies used more than one human subject and also used animal subjects; observations were made under many different conditions. Thus the same experiment can be verified, since the critical conditions are carefully described.

Many psychological problems cannot be handled successfully by the experimental method. For example, we cannot experiment with some of the important patterns of human adjustment such as marriage, sexual behavior, delinquency, and crime. We can experiment only in a limited way with such aspects of human behavior as emotion and motivation. Many of the critical factors controlling behavior cannot be varied systematically, at least in human subjects. For example, we cannot remove parts of the human brain to study the resulting effects on behavior. Some of our psychological knowledge is obtained by methods other than experimentation.

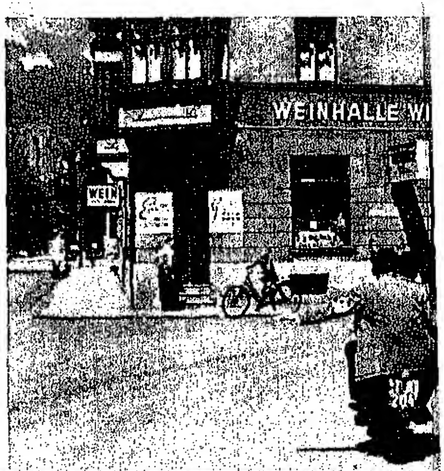
The field-study method. Human and animal behavior can be observed objectively and systematically in its natural setting without attempting to control or vary it. The field-study method has contributed immeasurably to our knowledge of animal behavior. Some of the world's greatest natural scientists spent major portions of their lives "in the field," observing and cataloguing the behavioral events in the lives of ants, bees, migrating fish, eels, birds, and butterflies. Darwin formulated his theory of evo-

a

b

Figure 1.5. The experiment applied to a problem in visual The subjects wore glasses whi reversed their visual field so th on their behavior could be stu a, showed very little adjustme upside-down world, but the hu learned to adapt fairly well to visual cues after wearing the g weeks. (Courtesy Dr. Ivo Kol the University of Innsbruck.)

c



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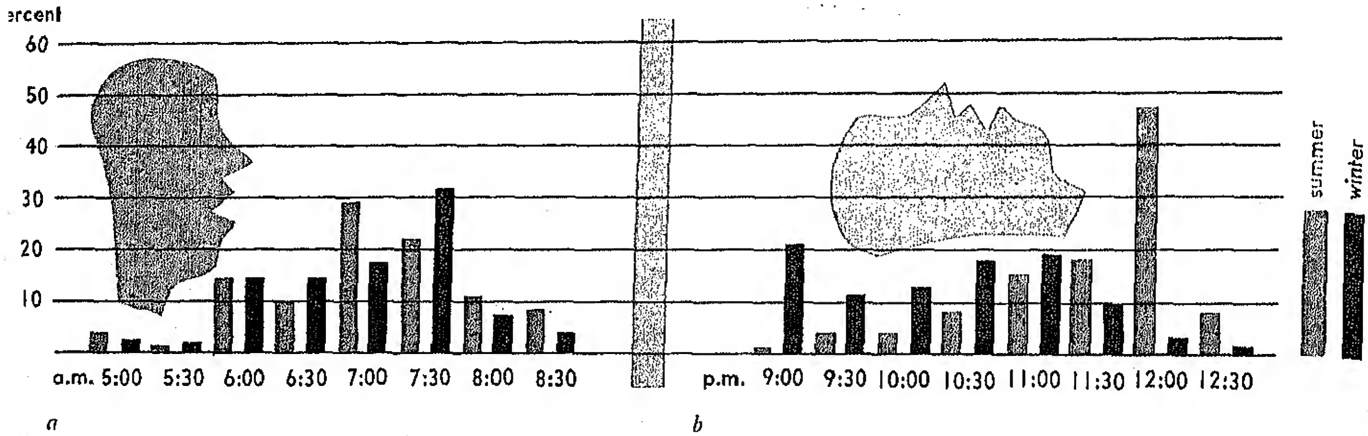

igure 1.6. *The field-study method sed to study the influence of changed nvironmental conditions on patterns f sleep and wakefulness. In the arctic ity of Tromsö, Norway, there are two ionths of complete darkness in inter and two months of constant aylight in summer. These changes iade very little difference in the time eople got up in the morning,* a, *but esulted in their going to bed earlier in inter than in summer,* b. (Adapted rom Kleitman, N., and Kleitman, H. he sleep-wakefulness pattern in the rctic. *Sci. Monthly,* 1953, *76,* 49–356.)

lution on the basis of field-study observations.

The field-study techniques of psychology are a familiar feature of our national life. Political polls, attitude surveys, studies of commercial products—these all show psychology at work using the field-study method. Let us look at an example of this kind of scientific study.

Two scientists interested in the influence of unusual environmental conditions on patterns of sleep and wakefulness studied the sleep habits of people who live north of the Arctic Circle in Tromsö, Norway. In Tromsö there are two months of complete darkness in winter and two months of constant daylight in summer. In this field study, direct observations were made on the "night life" of Tromsö in the summertime by counting the number of people who passed a particular central point at different hours of the day and night. A sample of the population of the town was interviewed in order to determine their daily patterns of sleep and wakefulness in summer and winter.

The observations of street traffic revealed that shortly after midnight in summer the streets became deserted, except near the harbor, where passenger steamers docked at night. In spite of the fact that broad daylight lasted throughout the summer nights, no one was on the streets. Some of the results of the interviews are shown in Figure 1.6. The time of getting up in the morning was fairly constant throughout the year. The bar graph in Figure 1.6*a* shows the percentage of people who got up at 5:00, 5:30, 6:00, and so on until 8:30 A.M. in summer (colored bars) and winter (black bars). The time of going to bed was markedly different from winter to summer. In the wintertime, people started going to bed by 9:00 P.M. when the municipal electricity was turned off, and almost everyone was in bed by 11:00 P.M. By contrast, summertime found most of the inhabitants of Tromsö staying up all evening. More than half of them went to bed at midnight or later. The bar graph in Figure 1.6*b* shows the percentage going to bed from 9:00 P.M. until 12:30 A.M. summer and winter. The average night's sleep was about one hour longer in winter than in summer.

The authors concluded that the seven hours of sleep which most people of Tromsö got during the summer months is

probably enough for the average normal adult. The people went to bed earlier in the wintertime because they were not motivated to stay up. They got more sleep because there was nothing else to do.

The life-study methods. Many psychological observations are in the form of studies of the life histories of individuals, wherein attempts are made to understand the causation of certain characteristics of behavior and personality by tracing their development in relation to possible influencing factors. Studies of child development following this method consist in systematically recording the child's behavioral history over a period of time.

The most commonly used life-study method is the *clinical method.* In medicine, the clinical method refers to the procedures for determining the nature of a disorder in an individual by collecting information about his own history of health and illness. As its name implies, the clinical method is based on observation of people who come to clinics, or to professionally trained doctors or psychologists, for treatment of a disorder. Much general knowledge in medicine is gained by studying individual cases. The same is true in psychology. In this area, the clinical method is used to study the development of behavior patterns in the individual as they are related to both normal adjustment and behavior disorders.

The use of life-study methods in the attempt to understand the characteristics of executives in industry is diagrammed in Figure 1.7. Some three thousand executives were studied in twenty-five large industries. First, each executive was rated independently by five associates as to whether or not he was promotable, satisfactory, or inadequate in doing executive work. Next, each executive was given a battery of psychological tests and a long interview to determine his past activities and his present characteristics. Records concerning the nature of his job activities were also obtained. In the third stage, the test results, interview analyses, and case history of each executive were examined to determine the presence or absence of thirty characteristics such as the eight shown in the figure—drive, motivation, creativeness, etc.

Figure 1.7. The life-
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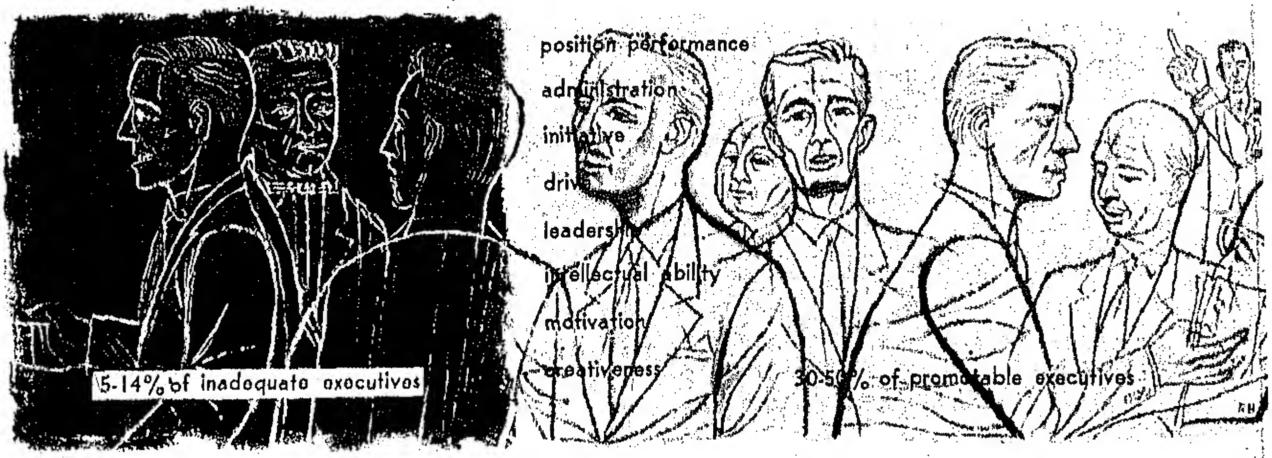


Finally, the records of the executives rated as inadequate and those rated as promotable were examined to determine the frequency with which each of the thirty characteristics showed up in each group. The eight most significant characteristics, as shown, were found to be present in 30 to 50 percent of the executives in the promotable group and in only 5 to 14 percent of the inadequate executives. Other characteristics, among the thirty studied, which were observed to distinguish less consistently between inadequate and promotable executives included acceptance by others, socialness, analysis and judgment, planning, flexibility, and accomplishment.

This study illustrates both the strong and weak features of the life-study and clinical methods. These methods lend themselves to analyses of behavior in practical and general problems of adjustment. By virtue of the complexity of some of these problems, the general features of conduct studied often cannot be defined and measured precisely, and careful control over all phases of observation cannot be achieved.

The great advantages of the clinical methods go beyond the type of life study we have just described. These methods are essential in exploring the causation and background of behavior in a particular individual. They must be used for many problems which cannot be brought into the laboratory for study. Moreover, the results of clinical studies and life studies in general add greatly to our fund of psychological knowledge. This information can lead to the more definite formulation of psychological problems and how they can be studied profitably by any of the scientific methods.

Methods of Handling Facts. The scientist's work does not stop with making observations and collecting data. His data are useless to him unless he can handle them in meaningful ways and thereby derive interpretations of general significance. An indispensable part of the scientific method is to be able to describe events and their interrelationships in precise quantitative ways.

Statistical procedures. Most of the descriptions of events in the physical sciences are very exact and can be expressed by mathematical formulas. In the science of behavior, the events with which we deal are so complex and are influenced by so many variables that we approximate valid descriptions only by making many observations and many measurements in different individuals and under different conditions. In order to collect, classify, tabulate, and interpret our numerical facts, we depend upon the procedures of statistics.

The statistical methods are among the most important tools that psychology uses. They aid in constructing psychological yardsticks with which to measure complex behavioral characteristics, and are indispensable in discovering significant relationships among events where such relationships are obscure to direct observation. When it is impossible to control all the variables in an experimental situation, statistical methods in effect control some of the variables for us. To indicate how important these tools are to psychology, we shall describe briefly a study in which advanced statistical procedures were used to discover the common denominators or basic factors in complex behavior patterns.

As we have said, one of the important uses of psychology is to devise tests to

measure all manner of psychological characteristics. It is important in large organizations to be able to select people for specific jobs on the basis of their performance on aptitude tests. In the study we are describing, several hundred Air Force recruits were given forty performance tests—such as tests of ability in balance, posture, pursuit of a target, reaction time, coordination, rudder control as in flying an airplane, steadiness, tracing, tapping, and aiming. The scores of the recruits were then used to try to determine how many basic psychological factors were actually involved in the forty tests.

Statistical analysis of the scores showed that a few factors were common to many tests. All the major variations in performance could be accounted for by ten primary factors, including the four shown by the hands in Figure 1.8. Once the ten basic abilities were determined, the nature of the tests could be revised to get more refined measures of them. In this way statistical methods are used to improve testing procedures and simplify the problem of selection of personnel. *Factor analysis* is the term for the procedures used to analyze many types of measures in order to identify a few common factors.

Descriptions of facts. Sometimes psychologists put descriptions of behavioral events into general verbal form. Whenever variations, differences, or relations in behavior are to be understood, quantitative or graphic forms of description are used. The nature of the data determines what kind of description is used and how the description is arranged. Figure 1.9 gives examples of various kinds of quantitative and graphic descriptions which will be used frequently in this book to describe behavior.

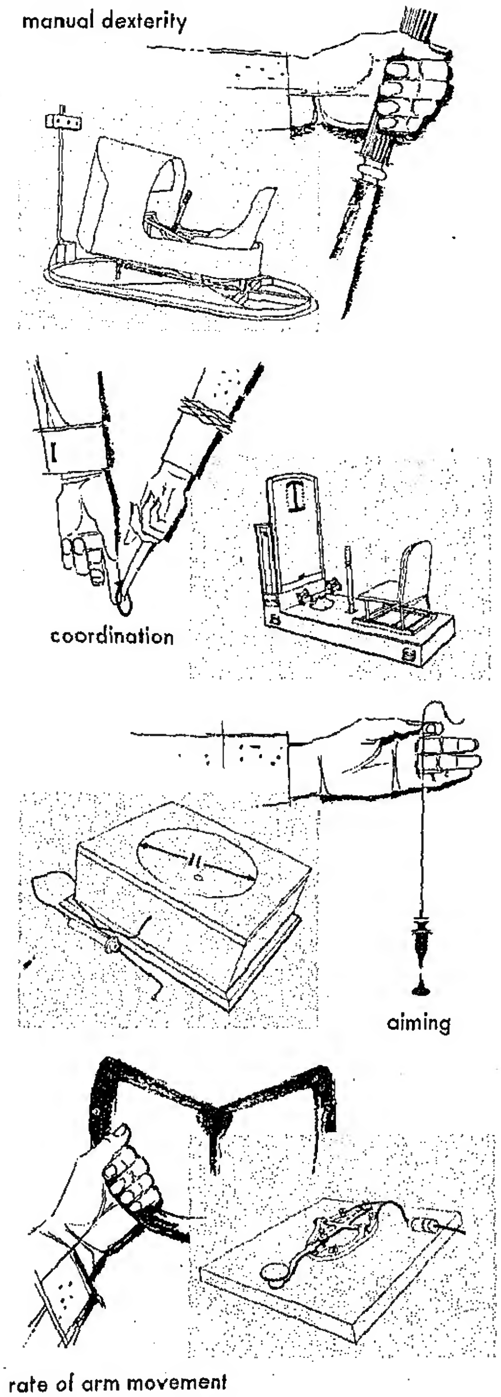


Figure 1.8. Some basic factors involved in motor ability, identified by the statistical procedures of factor analysis. (Based on Fleishman, E. A. Dimensional analysis of psychomotor abilities. *J. exp. Psychol.,* 1954, 48, 437–454.)

The graphic record, as shown in Figure 1.9*a*, gives an indication of how behavior changes in time. The man's blood pressure and pulse are being recorded by an air-pressure recording pen which moves back and forth across a slowly moving paper tape, producing a continuous record. Such graphic records can be measured and studied in order to obtain detailed information about the time of occurrence, the intensity, and the frequency of responses.

The numerical table is familiar to everyone. The example we show in Figure 1.9*b* indicates what a random sample of people in a large city think psychologists do. Fifty-eight percent thought psychologists do clinical work, 45 percent thought they carry on research and study, 4.9 percent thought they are employed in industry, while 21.6 percent did not know what such people do.

The bar graph presents data in a manner very similar to the numerical table. As shown in Figure 1.9*c*, we use a bar graph when we want to show the frequencies or relative percentages of a set of separate or discrete measures. The bar graph of hits on a target indicates the number of people making certain score levels in operating a recording punch press.

Whenever there is a continuous variation in behavior in relation to some independent variable, we can show this relation in terms of a line graph. The line graph in Figure 1.9*d* shows how sexual potency in man varies continuously in relation to age. The percentage of potent males in a sample is plotted on the vertical axis, or *ordinate*, of this graph, while the age of different groups studied is plotted on the horizontal axis, or *abscissa*. The graph tells us that almost all males below age forty are found to be potent, while at age seventy only 75 percent are potent. Between ages seventy and eighty there is a very sharp drop in sexual potency.

When we wish to describe the pattern of several measures of response or of personality, we can use a special bar or line graph called a *psychographic profile*. Figure 1.9*e* compares the psychographic profiles of the personality characteristics of a group of normal individuals with a group of sixty convicts who were tested upon admission to prison. The heavy horizontal line through the center of the graph represents the scores of normal individuals, while the colored line shows the prisoners' scores. The prisoners show significant differences from the normal group in two main respects: on the scale of social attitudes (point 4 on the profile) and on a scale of emotional tension (point 9).

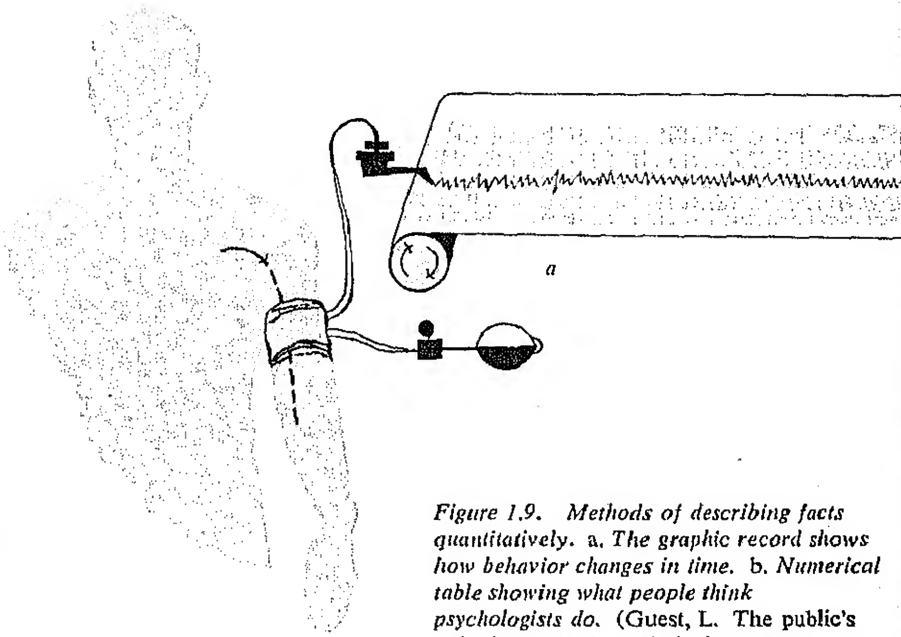
HISTORY AND SYSTEMS OF PSYCHOLOGY

Man's interest in psychology has a longer history than the word itself. Psychology, from the Greek words *psyche* and *logos*, means, literally, the study of the mind or soul. Speculations and theories about the nature of the "psyche" formed a part of the most primitive cultures. Until relatively recent times, most theories of the mind conceived it to be a substantial entity which dwelt within the body. Greek thinkers were much concerned over what bodily organ housed the mind—the heart, the lungs, the liver, or perhaps the head. This last notion has proved to be a lasting one, for people today are inclined to locate the mind within the brain.

Psychology evolved as a distinct area of study within the broader discipline of philosophy, and was originally considered

	task	percent
1.	clinical work	58.2
2.	business, industrial	4.9
3.	research and study	45.3
	a. people in general	(4.2)
	b. human behavior	(10.3)
	c. the mind	(23.8)
	d. mental disorders	(3.5)
	e. psychoanalysis	(1.6)
	f. personality	(1.9)
4.	teaching	1.9
5.	miscellaneous	13.8
6.	don't know	21.6

b



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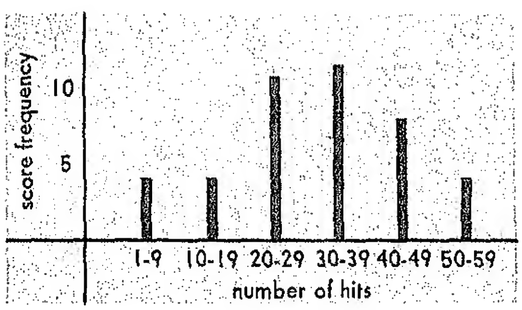

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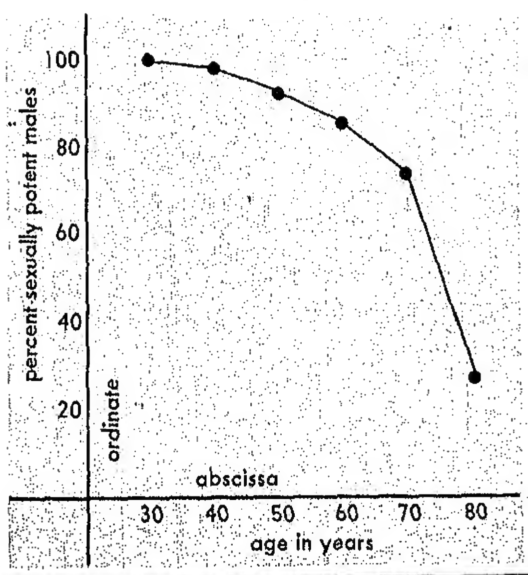

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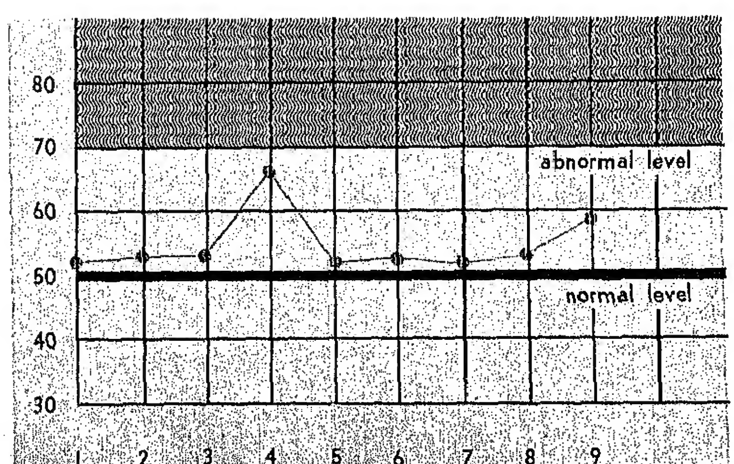


Figure 1.9. Methods of describing facts quantitatively. a. *The graphic record shows how behavior changes in time.* b. *Numerical table showing what people think psychologists do.* (Guest, L. The public's attitudes toward psychologists. *Amer. Psychol.*, 1948, 3, 135–139.) c. *Bar graph showing the number of hits made by 43 subjects operating a recording punch press.* d. *Line graphs showing sexual potency in human males as a function of age.* (Data from Kinsey, A. C., Pomeroy, W. B., and Martin, C. E. *Sexual behavior in the human male.* Philadelphia: Saunders, 1948.) e. *Psychographic profile of personality test scores of a group of convicts compared with a normal group.* (Data from C. Gallenbeck.)

a study of the mind, or mental events. Many new students of psychology find it hard to understand the modern emphasis on behavior. Do we then not recognize the mind? Do we deny the existence of mental activity?

The best answer we can give to these questions is that while psychologists recognize all kinds of human activities, including those which people are accustomed to call mental, they have found it unnecessary to postulate the existence of a mind, as distinct from the body. Psychology became established as a science only when it abandoned the mind as an entity and turned its attention to the observable events of behavior. The phenomena of personality, thinking, learning, language, perception, and emotion are studied as forms of behavior and are described in objective terms. There is no reason to believe that mental events differ in any fundamental way from any other kind of behavior or that they require any special principles of description. The so-called mental activities, like other types of human behavior, are functions of the behaving organism.

The Historical Picture. The course of psychology as a science was originally defined by fundamental discoveries about the nature of human behavior and the behavior of animals below man. The chronology of some of these most important discoveries can be seen in the cut through the historical tree of psychology in Figure 1.10. This overview of the great experiments and investigations in psychology is shown as beginning around the start of the nineteenth century.[2]

Physical and biological scientists carried out experiments in psychology before this field was recognized as a separate science. One of the first systematic experiments was made on sensory discrimination by the German anatomist Weber. Before the first laboratory of psychology was organized, Helmholtz, a physicist and physiologist, had made lengthy studies of color, space, and sound perception. Darwin published his major work before psychology was established as a science. His theory of evolution applies to behavior as well as to body form and function. Other important investigations which preceded psychology were Galton's studies of individual differences.

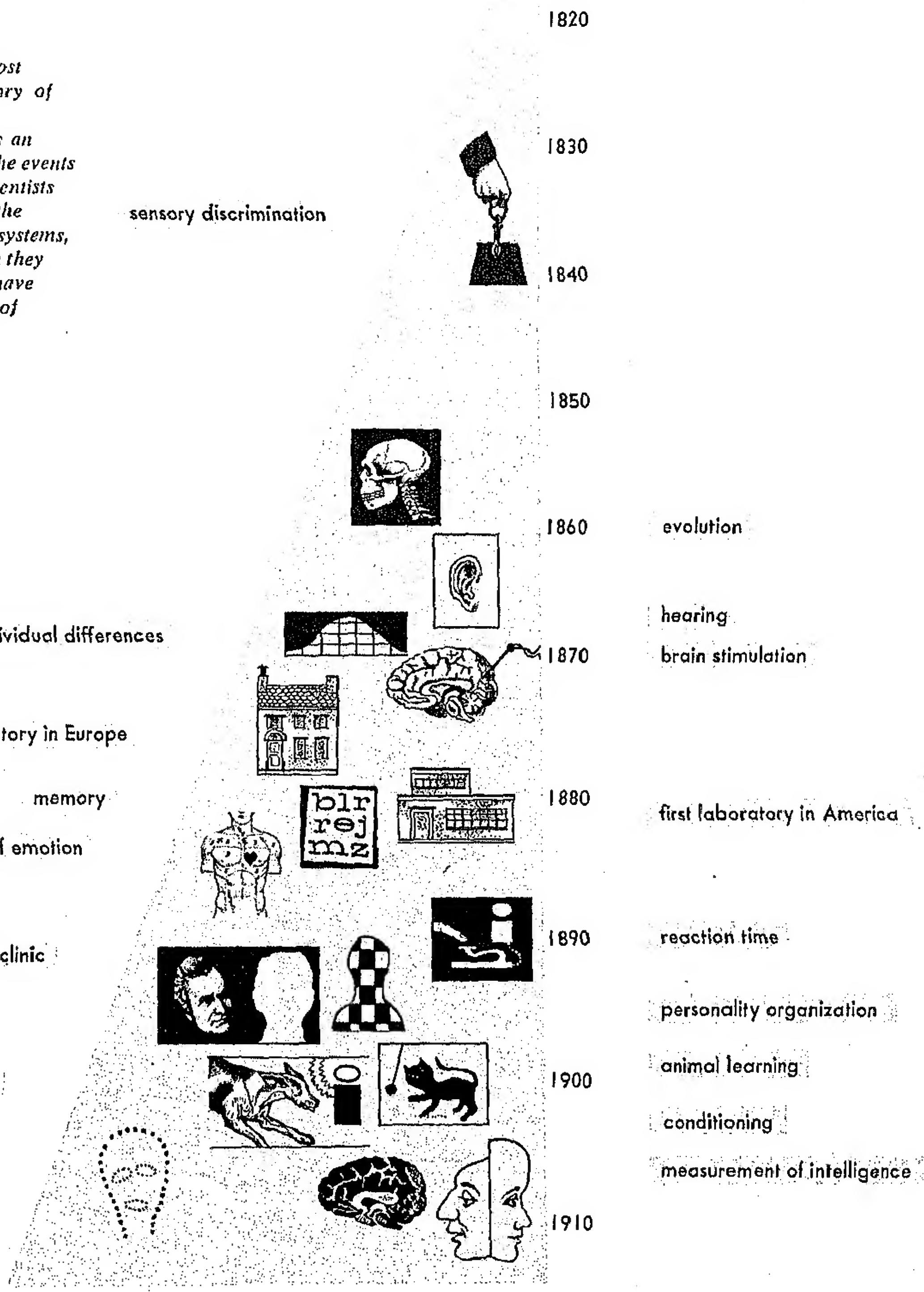
As shown in Figure 1.10, the first laboratory of psychology was established in 1879 by Wilhelm Wundt at the University of Leipzig in Germany. Early studies there dealt mainly with problems of perception. An American psychological laboratory was first organized at Johns Hopkins University in 1883. A clinic for the study of psychological problems in children and college students was set up at the University of Pennsylvania in 1896.

Some of the major lines of experimental discovery also are shown in Figure 1.10. Three of the definitive early studies in the field of perception are Weber's studies of weight discrimination, Helmholtz's work on vision and hearing, and Wertheimer's observations on the principles of perceptual organization.

The field of learning and memory owes much to Darwin. His theories stimulated the experimental study of intelligence and learning in different animals. Among the investigations of learning, the experiments of the Russian physiologist, Pavlov, on conditioned reflexes have been perhaps the most important in influencing modern concepts of psychology.

Psychology has thrived on measure-

Figure 1.10. *Some of the most important events in the history of scientific psychology. Before psychology was established as an independent science, some of the events of behavior were studied by scientists in related fields. We identify the earliest psychologists with the systems, or schools of thought, to which they adhered. All of the systems have contributed to our knowledge of behavior.*



ment, particularly on the measurement of individual differences in people. Galton's first attempts to devise tests of human capacities and to develop principles for use in the measurement of individual differences were followed later by outstanding work on measuring motor reactions and intelligence. The observations and theories of the Viennese psychiatrist, Sigmund Freud, marked a major advance in the psychology of individual differences. Freud developed the theory of psychoanalysis and formalized the procedures of psychotherapy or psychological treatment in modern medicine.

A fourth series of great experiments which affected the growth of psychology dealt with studies of the activity of the brain in behavior and with the bodily basis of human emotion. The way the body operates in behavior has been one of the important problems not only of psychology but of biology in general. How the brain regulates response, how it is affected in its action by disease and injury, and how it functions in thinking and memory are continuing questions in psychology. But the sources of interest in the bodily bases of behavior go beyond these questions concerning the brain. Some of the most important questions of the modern biological sciences deal with the relations of the chemistry of the body and behavior, the mutual interplay of the chemical states of the living system and the processes of adjustment.

Systems of Psychology. Understanding behavior in all its diversity was an impressive task for a new science. Of necessity, the early psychologists, as well as psychologists today, have been able to study and observe relatively restricted parts of the whole field. Some psychologists or groups of psychologists have been impressed with the significance of certain limited aspects of behavior to the extent that they have been inclined to interpret all psychological phenomena in terms of their own interests. We refer to these overall interpretations as *systems* of psychology.

Some of the most important systems of psychology have developed as a result of major innovations in methodology. A fresh and original approach to scientific problems can be responsible for establishing a wholly new field of research complete with its own interpretations and theories.

Introspectionism. The early psychologists in Europe and some of their followers in America were concerned not with observable behavior but with the content of their own conscious experience. They believed that they could analyze the "mental elements" making up complex experiences by the experimental procedure of introspection—the "looking into" their own consciousness. Many of the problems they studied were in the field of perception. The introspectionists thought that all perception was made up of units of consciousness called sensations which, along with images and feelings, made up the content of conscious experience.

Psychoanalysis. The work of Freud was an important approach to the understanding of behavior quite independent of the new science of psychology.[3] Freud was a clinician who developed a theory of human personality based on studies of his patients. His ideas are popularly known primarily for their emphasis on sex as a motivating force in behavior and personality. The central feature of Freudianism, however, is the notion that underlying conscious experience and behavior is the realm of unconscious needs and desires which drive the

human personality in action. In working out his theories, Freud developed a method of treatment for behavior difficulties which has come to be known as *psychoanalysis*.

Although Freud's ideas have undergone much revision by his followers, his impact on psychology has not diminished. Since many of his ideas are stated in nonobjective terms, they are difficult to incorporate into scientific psychology. Nevertheless, Freudian interpretations of some of the patterns of human conduct have had a profound influence on psychological thinking.

Gestalt psychology. A group of European psychologists led by Wertheimer broke away from introspectionism because they felt that it gave false interpretations of perceptual experience.[4] The introspectionists tried to reduce all consciousness to elemental units. Wertheimer pointed out that our perceptions are not atomistic but are organized into perceptual patterns or forms. For example, when you see a flag, your experience is not made up of numerous sensations of redness and whiteness and blueness. Rather, you see a "flag," an organized whole or configuration—in German, a *Gestalt*. The organization of perception is illustrated in Figure 1.10 by the face made up of dots. You do not see the dots as separate units; you see them as a whole, as a face. Although gestalt psychologists have been primarily concerned with the study of perception, they have attempted to extend their ideas to an entire systematic interpretation of psychological events.

Behaviorism. Psychology took on new meaning and direction as more and more psychologists abandoned the study of conscious experience, or the mind, in favor of the facts of observable behavior. Whereas the method of introspection can be applied only to one's own experience, behavior can be studied in all living organisms, human and subhuman. A great impetus to the objective study of behavior was furnished by the experiments of Pavlov, who discovered the phenomenon of the conditioned reflex.[5] In a typical Pavlovian conditioning experiment, a dog which would salivate when presented with food was taught to salivate to conditioned stimuli, such as a bell or a light, by being presented such a stimulus just prior to the food. There is a picture of a dog being conditioned in Figure 1.10.

The facts of conditioning were seized upon by many psychologists in Russia and America as the basic principles to apply to the understanding of behavior. Psychology in Russia is still dominated by Pavlovian thought. In America, John B. Watson incorporated the principles of conditioning into what he called *behaviorism*.[6] He tried to interpret all behavior in terms of unconditioned reflexes and learned or conditioned reflexes. He also emphasized the importance of environmental influences in development as opposed to hereditary factors. The principal weakness of Watson's behaviorism was that it was just as atomistic as introspectionism. The introspectionists tried to build up complex experiences out of unitary sensations, while Watson attempted to account for complicated patterns of behavior in terms of series of conditioned reflexes. Neither of these theories presents a meaningful interpretation of the activities and adjustments of the individual.

The overall course of psychology in America has been influenced by all of the systems we have discussed but has been broader than any one of them. From the start, the main current of American psy-

chological thought has been characterized by a *functional* approach to the problems of behavior. The first great American psychologist, William James—along with Dewey, Thorndike, Angell, Woodworth, and others—was interested in everything the individual does, whether it is perceiving a pattern of light and color or adjusting to a problem situation. Major experiments, methods, and interpretations—from whatever source—have contributed to the general trend of functional psychology. The broad interests of some of the early functionalists extended psychology from a restricted laboratory science to its applications in areas of human adjustment, especially in the educational and clinical fields. Today the "isms" have largely disappeared from the psychological scene. Although psychologists differ in their interests, their methods, and their interpretations, they have a common meeting ground in the generally accepted scientific principles which govern their work.

SUMMARY

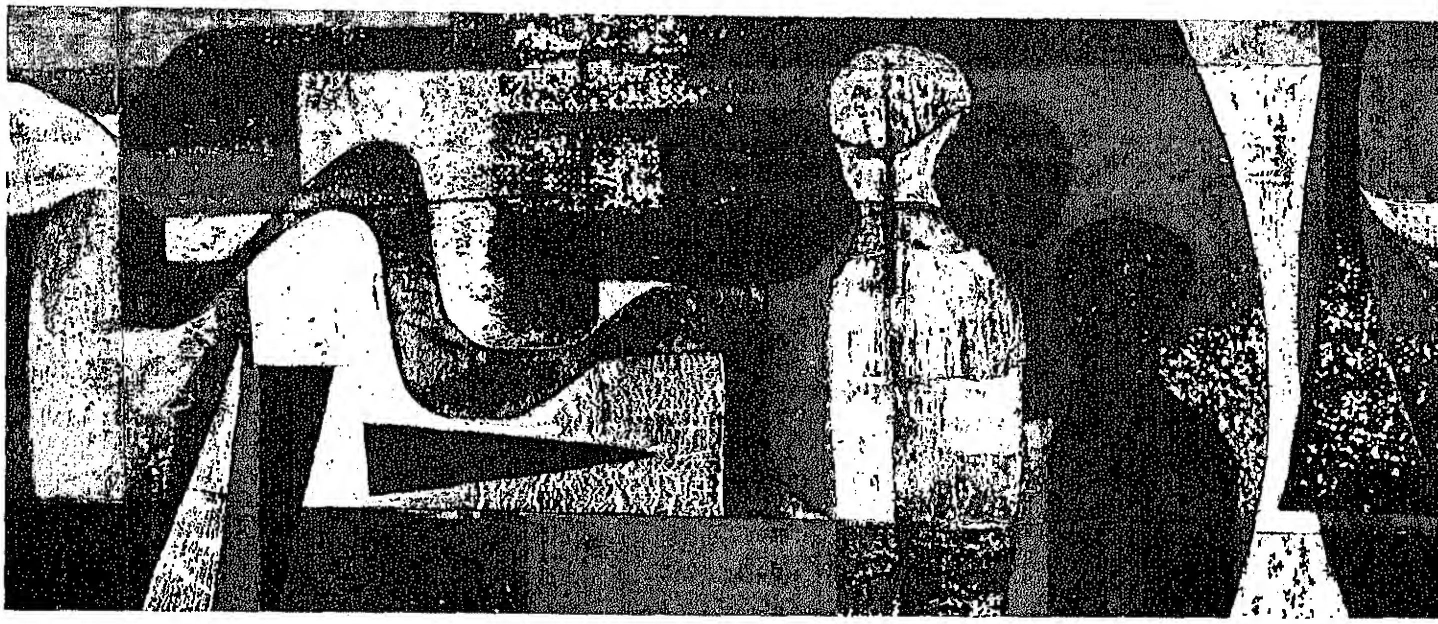
Psychology studies both observable or overt behavior and implicit behavior. Behavioral events are responses of a living organism to its environment. Systematic observations of behavior usually require special methods and often make use of elaborate apparatus to measure stimuli and responses.

Psychology is subdivided into genetic psychology, comparative psychology, physiological psychology, social psychology, and the areas which deal with personality and adjustment. All of these fields contribute to our knowledge of general psychology, which deals primarily with the basic mechanisms of behavior. Applied psychologists work in testing, educational and training fields, human engineering, public relations activities in business, industry, and government, and counseling.

As a science, psychology applies objective methods of observation to problems of description, causation, prediction, and control of behavioral events.

Psychology uses several methods of collecting objective data. The experimental method has the advantage of systematic control of variables, making possible repetition of the observations. Since the experimental method cannot be used in all behavioral situations, psychologists also depend on field-study and life-study methods. The most widely used life-study method is the clinical method.

Psychology was established as an independent science late in the nineteenth century. Various approaches to the subject matter of psychology were organized into a number of diverse systems, all of which have contributed to research and theory in the science as a whole. The "isms" in psychology tend to disappear as it takes its place as a mature science.



CHAPTER 2. ADJUSTIVE BEHAVIOR

We begin our adventure into the science of psychology not in the laboratory but at home, at school, at work, in all of the familiar life situations. We are going to try to understand how the psychologist describes the interactions that occur between an individual and the events that determine the course of his behavior. Human behavior involves a continuous series of adjustments to all manner of changing situations. We can learn much by examining these adjustments as they occur in their natural settings. Only later will we turn our attention to a detailed analysis of patterns of behavior and the factors that define them.

Our task in this chapter is threefold. First of all, we are going to "get the feel" of psychological description and analysis by examining some ordinary patterns of adjustment as well as several controlled studies of adjustment behavior. In this way we shall begin to understand how psychologists formulate the problems of behavior and how they proceed systematically to obtain detailed and accurate information. Our second task is to get a preliminary understanding of the methods of psychological measurement, without which our knowledge of behavior would be little more than interesting anecdotal observations. Finally, we are going to preview some of the general principles of the science of behavior, principles which will serve to integrate and give meaning to the more detailed analysis of behavior yet to come.

Behavior as Adjustment. In Chapter 1 we learned that the essential characteristic of behavior is that it is the response of a living organism to its environment. We usually think of the environment as those objects and events outside of our bodies. The world we live in, the people we see, the objects we use, are all parts of our *external environment.* We react to this environment in countless ways. Cold weather, for example, causes us to dress more warmly, put antifreeze in the car, or check our fuel for the furnace. The aspects of the environment to which the individual reacts—light, sound, pressure—are called *stimuli.*

We live in another environment as well, enclosed within our own bodies. This *internal environment* consists of chemical substances, pressures, distentions, and mechanical displacements. Although we are often unaware of the internal environment, it helps regulate bodily temperature, digestion, circulation, and many other operations necessary for life. When we feel sleepy, hungry, or thirsty, we are reacting to stimuli from our internal environment.

Since man never exists alone, his behavior is also regulated by his *social environment.* Reactions are patterned according to the demands of family groups and all the other social groups to which the individual belongs. Furthermore, the influences of the culture and of national and racial groups are felt throughout life.

In day-to-day life we respond to the pressures of our external, internal, and social environments. And because we have the ability to learn and to remember, past environmental events also affect our present responses. Behavior is *adjustment* to the environment, past and present.

The adjustive nature of behavior is apparent in all kinds of responses. If we move from shade into bright sunlight, the pupils of our eyes adjust to the changed level of illumination. On a hot summer day our skin becomes flushed and we perspire freely so that our internal temperature can be kept at the proper level. When we feel hungry or thirsty, we eat or drink. When the telephone rings, we answer it. In countless ways the individual is stimulated to action by his environment, and by adjusting to it he changes the conditions of stimulation either by modifying himself or his environment.

In more general terms we speak of adjustment as the organization of behavior in life situations, at home, at school, at work, in growing up, in aging. Many people think of adjustment as the sort of reaction one must make to some shattering event which has disrupted his life. We also use the term in speaking of a person with a behavior disorder who must be led back to "good adjustment." It is true that many times in life radical changes in behavior must be made to correspond with radical changes in the environment, but adjustment behavior includes usual reactions as well as unusual. Scientifically, adjustment is neither good nor bad. It is the course of behavior an individual follows in relation to the demands of the internal, external, and social environments.

ADJUSTMENT IN HUMAN SITUATIONS

An individual's behavior is defined by the vital framework of a body structure that marks him as a human being, by an environment that supports and maintains this body, and by the family, the community, and the culture that molds him as

an individual. We first need to know the nature of adjustment in different phases of human living, for these social patterns of behavior determine to a great extent reactions to more specific environmental events.

General Adjustment Patterns. Significant patterns of human behavior cannot be understood in terms of single environmental stimuli and single responses. Human behavior is a continuous process of adjustment which goes on from birth—even before birth—until death. Each event in this long-term process is an adjustment to present conditions, but is also defined by all the events which have preceded it in the life of the individual. The meaningful continuity of behavior has two sources: the organization of the living system and the organized structure of the environmental conditions to which it adjusts.

The photographs in Figure 2.1 illustrate some of the life situations—the usual and unusual circumstances which set the course of human conduct—in terms of which human behavior is organized. Many of the features of adjustment in any particular person can be traced to the conditions which influenced his early growth and development. The child in Figure 2.1*a* is adjusting to kindness and tender care. This same child could also adjust, if necessary, to neglect, to rejection, to cruelty, and to near starvation. His life would be different in each situation, to be sure, but some pattern of adjustment would emerge. The individual's emotional habits and attitudes and his motives and goals in life are significantly affected by the satisfactions and disappointments of childhood.

Adjustment is a progressive thing. The school situation helps to set the pattern

a

Figure 2.1. The behavior of the individual is a function of the significant situations that make up his life. The opportunities and demands presented in the home, school, place of work, and other social environments, as well as unusual stresses placed upon him, set the course of his life patterns of adjustment.

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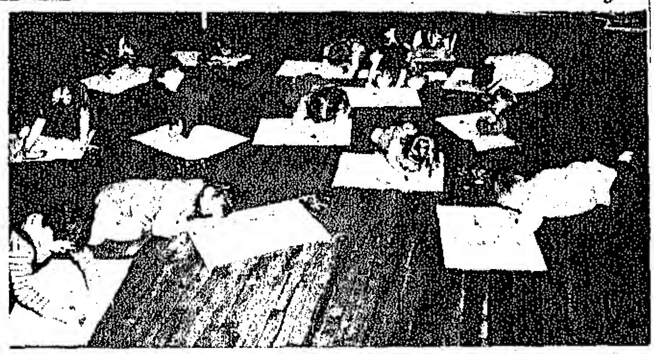

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of adjustment not only in the acquisition of knowledge and skill but in determining attitudes toward other persons, toward social groups, and toward the institutions of society. The kindergartners (Fig. 2.1*b*) and high school students (Fig. 2.1*c*) are gradually evolving patterns of skilled manual and social behavior which conform to the standards of society. But the same marvelously flexible, infinitely adaptable human characteristics that enable these students to acquire socially approved skills can lead, under different conditions, to habits and actions unacceptable to society. The delinquent child develops by the same psychological mechanisms of adjustment that underlie the organized behavior of everyone.

All of us are called upon from time to time to adjust to the stresses and difficulties which mark our lives. These stresses may arise from an injury or handicap (Fig. 2.1*d*), from environmental obstacles, from the requirements of work, or from the pressures of the social environment. Conditions of stress interrupt the ordinary routine of life and demand major readjustments on the part of the individual. In extreme conditions, the whole course of life may be altered as the individual acquires new emotional habits, new goals, and new knowledge and skill. The adjustment a person makes to difficulties and personal conflicts can take many forms. The man who is outstandingly successful and the one who is broken and bitter have made their own personal adjustment to the stresses, troubles, and pressures imposed upon them.

Individual Adjustment in College. The psychologist learns a great deal about modes of human adjustment by observing and studying the behavior of individuals, particularly those who come to him for help. Very frequently, problems arise in the course of a person's life which seem to him insurmountable. As long as he cannot make a satisfactory adjustment, his ordinary behavior patterns are disrupted and all phases of his life are affected.

The late adolescent or young adult in college encounters many problems related to the radical changes which are occurring in himself and in his environmental situations. We are going to examine four short case studies which have been taken without alteration of content from the files of the student-counseling service of a large university. They illustrate four common problems of adjustment related to independence from home, vocational choice, sexual relationships, and lack of academic ability. The four students described should not be considered abnormal. Many students come to counseling centers for help, and many others who do not use the service face similar difficulties.

Independence from home. Helen was an only child who had always been close to her parents, but during her sophomore year she felt a strong urge for greater independence from home. Her grades had dropped the previous semester and she had been placed on probation, causing her parents much anxiety. Several times a week they wrote or telephoned, criticizing her study habits, the amount of money she spent, and her general attitude, so that Helen felt alternately angry with the constant barrage of criticism from home and guilty because she was not living up to her parents' expectations. When her father announced that she needed discipline and that he therefore had written to her housemother, her adviser, and the Dean of Women, Helen rebelled. She stopped writing to her parents, went home with a girl friend for a weekend, and did not return to school.

She first announced that she would put herself through school to show her parents she could take care of herself, but later she attempted a reconciliation. Helen and her father were able to talk things out, but she could not get along with her mother. With her new understanding of her father, however, Helen returned to school determined to improve her school work and increase her independence.

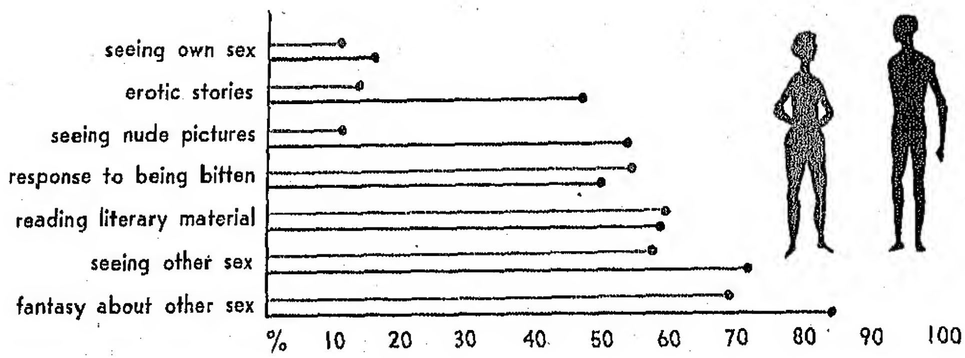
Vocational goals. Jim, a freshman, was a good-looking football player who made friends easily, made good grades, and had many interests, but was having difficulty in choosing a major. He thought he would like to be a high school coach, but hesitated because his father had lost a coaching job when the team lost too many games. Interviews and interest tests disclosed that Jim liked jobs dealing with people—teaching, coaching, personnel or social work. After talking with his teachers and parents, Jim decided to major in education, preparing to teach sciences, with a minor in sports. He felt that he would enjoy the work with young people and have an opportunity for sports work without encountering the insecurity his father found in coaching. Possibly the course Jim planned in his freshman year was changed as he gained experience and knowledge of himself, but he had evaluated and channeled his interests and had begun making decisions which would determine his future vocation.

Sex conflict. When Louise was a senior, she had to decide whether to break up with her boy friend Bob or to change her moral standards. Many girls encounter this problem much sooner than Louise, but she had been brought up quite strictly and had come to college shy and lacking in social skills. Bob was the only boy she had ever dated, and she felt that he had taught her a great deal about how to get along. She was quite fond of him but she feared he was a "ne'er-do-well," particularly since they had recently engaged in heavy petting. She did not approve of such activities before marriage and she did not want to marry him, but she hated to give him up because she had no one to take his place. She felt guilty and confused. As counseling progressed, Louise began to gain confidence in her social skills and grew disinterested in Bob. She made vocational plans which would allow her to live away from home and increase her social activities. Louise's sexual problem may have recurred when she again became seriously interested in a man, but past experiences, new social skills, and independence from home should have helped her adjust.

Low ability. George was a married Korean veteran who was failing most of his courses in engineering because of his low aptitude for college work. He decided to drop engineering, but did not want to quit school altogether, especially since his wife felt that he should have a college education. He decided to transfer to economics for business training and also applied for an office job when his grades did not improve. However, at the end of the semester, George was dropped from school for a year because of low grades. He accepted the office job, but still felt he might come back to school at the end of a year. In this case George did not adjust to his problem of low ability by changing his goals, but the school forced him to make other plans.

Problems such as these may seem a little dull and perhaps trivial to an outsider, but to the person involved they represent a major turning point in general patterns of adjustment. In each case the student had encountered an obstacle which, for the time being, interfered with his normal routine and prevented him from achieving any real satisfaction in life. In each case the factors contributing to the difficulty were complex and not entirely recognized. The problems as formulated by the students were not actually solved, but in each case a new mode of adjustment was finally worked out, involving shifts in values and attitudes as well as new social habits and skills.

Figure 2.2. *Percentage of men and women reporting sexual arousal to different kinds of psychological stimulation. These differences are apparently not based on learning so much as on basic differences between the sexes.* (Data from Kinsey, A. C., Pomeroy, W. B., Martin, C. E., and Gebhard, P. H. *Sexual behavior in the human female.* Philadelphia: Saunders, 1953.)



STUDIES OF GENERAL ADJUSTMENT

Studying individual adjustment in different human situations tells us something about adjustive behavior but, in order to collect a reliable fund of information, we need to study a great many people under a variety of conditions. Psychologists are interested in how behavior is defined by age, intelligence, sex, social status, stress, and many other variables. To see how these important problems of human conduct are brought within the scope of scientific research, we are going to look at some representative studies of general adjustment, each of which has made an important contribution to psychology. These studies have been selected because they illustrate some important principles of human behavior, because they introduce the student to some of the methods of psychology, and because each of them clarifies our ideas about areas of human conduct long befogged by misconceptions.

Interpersonal Adjustment and Sex. The understanding of sexual motivation and related emotional behavior is a major problem in the psychology of adjustment. Sexual behavior is restricted in many ways by social and cultural patterns, and successful sexual adjustment is often impeded by ignorance and misunderstanding.

Recent studies of interpersonal sexual activity in and out of marriage have made much use of controlled methods of study and measurement of some of the definitive factors. Kinsey and his associates interviewed thousands of men and women to obtain information about sexual adjustments. Figure 2.2 describes some of the information which they obtained. It shows graphically differences between men and women in regard to their sexual arousal by different kinds of stimuli. Basic differences of this sort between the reaction patterns of men and women are sometimes contributing causes of marital discord and misunderstanding.

Adjustment of Gifted Children. There have been many popular misconceptions about the personality characteristics of highly intelligent people. Often, brilliant people are thought to be social misfits, and physically weaker than people of average intelligence. The "genius" has often been thought to be especially susceptible to insanity.

Terman and his collaborators made a long-range study of a large group of gifted

children.[1] Out of some 250,000 California school children who were tested for intelligence in 1922, the highest 1300 were selected for further study. Periodic reports on these children as they have grown up and adjusted to adult life show that, in general, children of superior intelligence make superior adults. While this group was in grade school and high school, they were rated as being superior to children of average intelligence in health, physique, social adjustment, conscientiousness, originality, and leadership. In their college years, most of them had superior academic records and received more honors in student affairs than their classmates, although they were usually a year or so younger. When they became adults, most of them made normal or superior marital adjustments.

At the present time, many of these gifted individuals are highly successful in professions or business. The group as a whole rates above average in vocational achievement, earning power, social adjustment, and health. There are, of course, exceptions to this general trend. High intelligence is no guarantee that the individual will adjust satisfactorily, but comparison of this selected group with the general population indicates that its patterns of adjustment are generally superior.

Adjustment in Work. Investigations of adjustment in work have been important in all fields of human and industrial relations. Studies which determine the abilities needed for special jobs help select workers who can adjust most easily to such tasks. Studies of grievances and working conditions often lead to improvements which aid adjustment and contribute to increased production. A group of early experiments in this field provided such startling results that they stimulated a great deal of interest in the human relations aspect of work adjustment.

These studies, often called the "Hawthorne Experiments," were carried out in an electrical assembly plant in 1929 and 1930. Their original purpose was to determine the effects of improved working conditions on production. A number of girls were taken off the regular production lines and placed in a special "Experimental Test Room," where they continued to do the same type of work as before, under special conditions. During the first five weeks, their productivity increased, as shown in Figure 2.3*a*. In the second stage of the study (Fig. 2.3*b*) the special conditions were eliminated but pro-

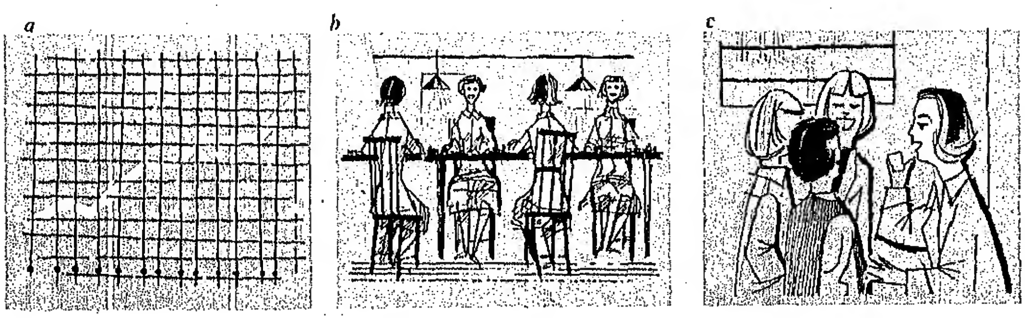


Figure 2.3. Experiment designed to test the effects of more rest periods, shorter working days, etc., on production. As a result of improved morale and human relations, work output continued to rise after special working conditions had been stopped. (From Roethlisberger, F. J., and Dickson, W. J. *Management and the worker.* Cambridge: Harvard Univ. Press, 1939.)

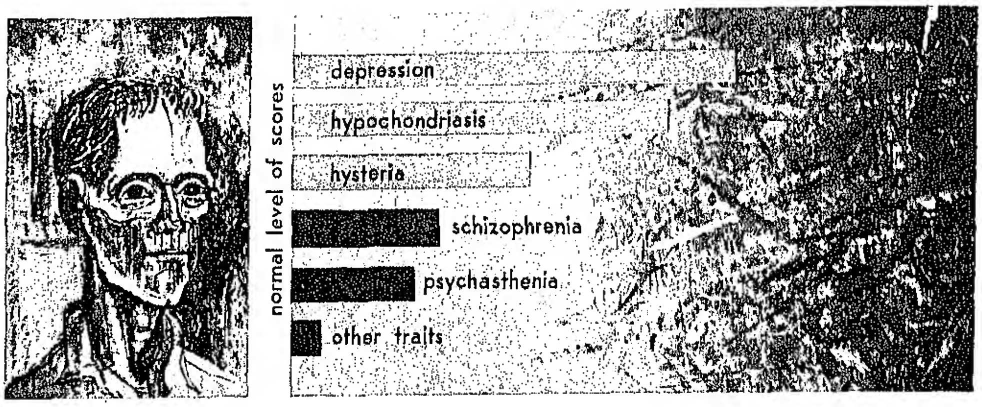


Figure 2.4. The effects of partial starvation on personality characteristics as measured by test performance. After 24 days of a minimal diet, the subjects showed reactions of depression, hypochondriasis, and hysteria which differed significantly from normal reactions. Other measured differences were not significant. (Data from Keys, A., Brozek, J., Henschel, A., Mickelson, O., and Taylor, H. L. *The biology of human starvation.* Minneapolis: Univ. of Minn. Press, 1950.)

ductivity continued to rise. It was apparent that the special conditions such as rest periods had not of themselves increased efficiency. Observations in the test room and interviews with the girls indicated that the changes in productivity were related to changes in the girls' attitude toward their work. Because they had been chosen for the experiment, they considered themselves privileged and important workers. As a result, they became motivated to do a more efficient job.

It was also observed that the personal relationship between the workers and the supervisor had improved. The supervisor allowed the girls more freedom and acted more as an observer than as a boss. Finally, from working together in a small group, the girls became more congenial and interested in each other (Fig. 2.3*c*), and a leader emerged who helped to set a higher level for the production of the group.

These studies, which began as an investigation of physical conditions, produced results which emphasized the importance of interpersonal adjustments in work. An immediate result was the establishment of an interviewing and counseling program for the workers in this plant. The studies also led to a widespread change in the point of view of industrial management. The worker is no longer considered a depersonalized element in the economic process, but an individual whose adjustment to his work is as important to the company as it is to himself.

Adjustment to Stress. Many critical patterns of human behavior are organized as adjustment to conditions of *stress.* By stress we mean a situation which is unusually demanding of the resources of the human organism. Psychological stress may occur in relation to strongly emotional situations or a conflict of motives. In Chapter 3 we shall consider in some detail the modes of reaction to psychological stress. Stress may also be physiological, arising from bodily injury or from deprivation of one or another of the body's primary needs, such as food or water. We are going to describe here studies of adjustment to extreme conditions of food deprivation.

A series of experiments on the effects

of partial starvation has been carried out at the University of Minnesota, with conscientious objectors to military service serving as subjects. In one experiment lasting twenty-four weeks, the subjects were fed a diet of barely enough calories to maintain the body. Careful observations of their behavior were made before, during, and after the semistarvation period. Among other observations, a personality test which compares the attitudes of an individual to attitudes found in mental patients was given to the subjects before the experiment, halfway through, and at the end.

Three of the characteristics of adjustment which were measured by the test were found to change during starvation, as shown in Figure 2.4. The subjects became more depressed and they complained more of feelings of illness which had no organic foundation (hypochondriasis). Furthermore, they became more emotionally unstable, as shown by a change in scores on the part of the test which measures hysterical symptoms. Other attitude characteristics measured by the test varied during the experiment, but the changes were not large enough to be considered significant variations.

Other systematic observations of the conscientious objectors during the course of semistarvation confirmed the results obtained with the psychological test. As the experiment progressed, the subjects lost interest in others, dreamed of food, and had little interest in anything else. Their sleeping habits and work habits were disturbed. They developed marked anxiety and feelings of depression. The difficulty of adjusting to the stress of semistarvation was reflected in changes in behavior and emotional disturbances.

Adjustment to Prison. A pattern of adjustment can be understood only in terms of the environment in which it occurs. The social environment is particularly important in channeling behavior. On the campus, at work, or in military service, certain types of behavior are encouraged or required and other types are discouraged or punished. Thus, behavior may be approved in one situation and disapproved in another. As a result, certain persons adjust more easily to one situation than to another. A young man who gets along very well in college will not necessarily make a satisfactory adjustment to military life. The following study investigates the factors leading to satisfactory adjustment in prison.

The purpose of the study was to discover the differences in standards of adjustment acceptable to prison authorities and those approved by the outside world. Sixty inmates of a midwestern state prison, considered one of the well-run prisons of the country, were studied. Prison-approved standards of adjustment were obtained by having guards and the supervisors of prison industries rate each prisoner on an adjustment rating scale designed for this study. The prisoners were rated on: (1) social factors, such as getting along with other prisoners, and maturity of social behavior; (2) vocational factors, such as interest and production in work, and handling responsibility; (3) personal factors, such as emotional stability, self-confidence, and general outlook on life; and (4) behavioral factors, such as physical condition, energy and motivation, and absence of complaints. Bad-conduct reports, turned in on prisoners who failed to follow prison discipline, were used as another indication of adjustment in prison.

The ratings of the prisoners obtained

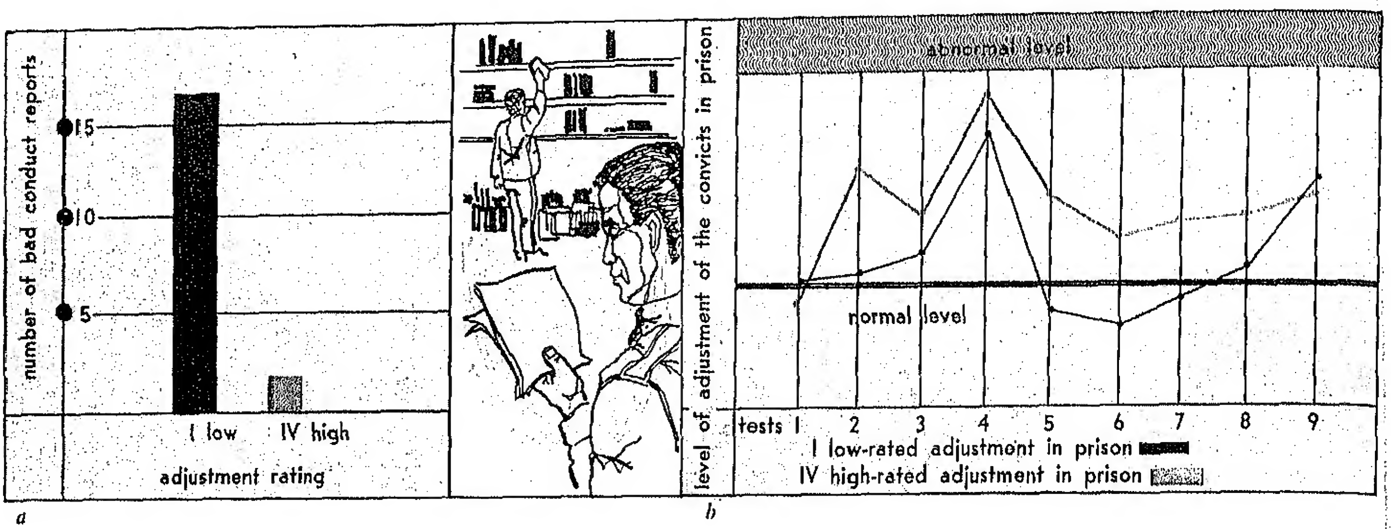


Figure 2.5. A "satisfactory" adjustment is judged according to the situation in which it occurs. Prisoners who were rated by their guards and supervisors as being poorly adjusted, a, *received more normal scores on a standard personality test,* b, *than prisoners who were rated as being well adjusted. The factors that make for good adjustment outside prison do not necessarily help prisoners get along with the prison authorities.* (Data from Driscoll, P. J. Factors related to the institutional adjustment of prison inmates. *J. abnorm. soc. Psychol.,* 1952, **47,** 593–596.)

from guards and supervisors were obviously based on what these authorities considered to be acceptable patterns of adjustment *inside* the prison. However, the prisoners were also compared to normal adult individuals in terms of their scores on a well-known personality test. The standards of this test are based on acceptable patterns of adjustment *outside* of prison—that is, in the normal adult population. The test includes nine scales representing different aspects of adjustive behavior. Thus the prisoners' behavior patterns were compared with normal adjustment on all nine scales.

The principal results of this study are described in Figure 2.5. The prisoners were first divided into four groups of fifteen men each, according to their adjustment ratings, with Group I including those with the poorest ratings and Group IV those with the best. The bar graph in Figure 2.5*a* shows the number of bad-conduct reports for Groups I and IV. Group I, with the poorest adjustment ratings, also had many more bad-conduct reports than Group IV, which had the best adjustment ratings. Thus the guards and supervisors were consistent in their judgments of the prisoners. The prisoners considered well-adjusted were, in general, those with the fewest bad-conduct reports, and those considered poorly adjusted were the group with the most bad-conduct reports.

A very different picture emerges in Figure 2.5*b*. In this graph, the groups rated best and poorest in adjustment by prison standards are compared in terms of the personality test—a standard test of adjustment outside the prison. In general, the best-adjusted group according to prison standards approached abnormality more closely than did the group with the lowest prison-adjustment ratings. This means that those prisoners who got along best in prison were definitely closer to the borderline of abnormal behavior according to outside standards than were those prisoners who got along most poorly in prison. The parts of the personality test on which the two prisoner groups showed the greatest differences were those that measured depression

and lassitude, feminine interests and attitudes, and secretive suspicion. High scores on these scales occurred in those prisoners who were rated "well adjusted" by prison authorities. Although these characteristics —depression, feminine interests, and suspicion—are not looked upon as desirable in men living in ordinary circumstances, they seem to help a man "get along" in prison.

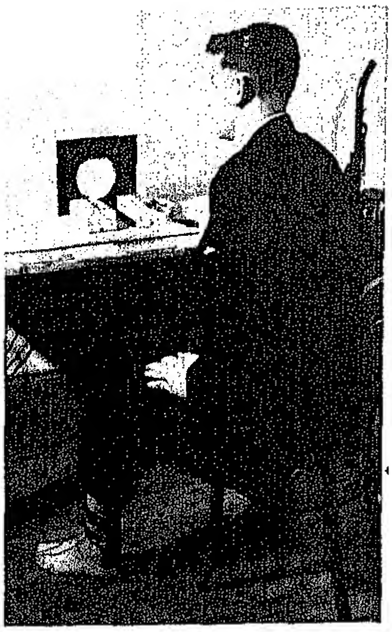
This study demonstrates that the same pattern of behavior can lead to "good" adjustment in one situation and "poor" adjustment in another. An adjustive behavior pattern is not good or bad intrinsically but only in the eyes of the people in a particular situation who approve or disapprove of it. As a scientist, a psychologist does not judge whether adjustive behavior is good or bad. His prime concern is to describe the situation, the behavior made in response to it, and the reactions of the individual and others to that behavior.

MEASUREMENT IN PSYCHOLOGY

Controlled studies of behavior like those we have just described differ in several important ways from observations of single individuals. The results of these studies have meaning beyond the situations in which they were carried out; that is, they have general significance in helping us understand something about behavior of people other than the subjects of the experiments. Each carefully controlled study is a stepping stone to more complete data, to more precise data, to a more comprehensive picture, or to a more accurate theory in psychology.

The characteristic of scientific studies that gives them their general, long-term significance is their quantitative nature. Psychology made little progress as a science until it was able to establish measurable facts and relationships in the realm of behavior. Since the methods of measurement are basic to our understanding of psychological events, we are going to consider some of the important principles and procedures of obtaining and handling quantitative data before going any further in our study.

(1) Psychological investigations measure differences in behavior. We may measure variation from person to person, such as the differences between men and women in reaction to sexual stimuli, or between prison inmates and other people in personality test scores. (2) Or, we may measure variations in response in the same persons under different conditions, such as the hunger subjects under normal and semi-starved conditions, or the electrical workers under different working conditions. The study of differences is fundamental to the main objective of psychology, which is the establishment of relationships in behavior between different aspects of stimulation and response. We want to know how aspects of behavior vary according to conditions in the environment and within the individual. (3) We also are interested in knowing how one aspect of behavior varies with another. Thus Terman's investigation of gifted children studied the relationship between performance in intelligence tests and other types of performance, general achievement, success in work, adjustment in marriage, etc. Basic to the study of differences and relationships is the ability of the psychologist to make valid and accurate measurements, both of stimuli and responses.



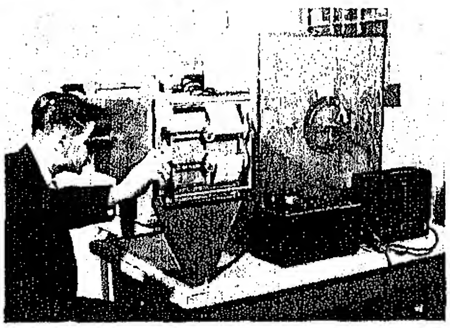


Figure 2.6. *Psychologists make quantitative measurements of behavioral events, as, in measuring reaction time,* a, *perceptual equivalence of visual stimuli,* b, *and performance on an intelligence test,* c. *Many behavioral measurements must be interpreted in terms of psychological scales.*

c

Measurement of Stimuli. As we learned in Chapter 1, a controlled psychological experiment depends upon the experimenter's ability to measure and control the stimulus variables. Sometimes, stimuli are varied according to such well-established physical scales as wavelengths or intensities of light, frequencies of sound waves, saturations of chemical solutions, and temporal intervals. In the starvation studies the amount of food given to the subjects was carefully measured and controlled.

It is a difficult problem in psychological experiments to recognize and control all of the environmental conditions which are influencing the nature of the subject's responses. In the Hawthorne studies the experimenters originally thought that the critical stimuli in improved production were the improvements in working conditions. As it turned out, the effective stimuli were the particular social conditions and interpersonal relationships that developed during the course of the study. These effective conditions were recognized because the experimenters arranged a controlled situation. The workers' production was measured under improved working conditions and then again after these conditions had been withdrawn.

Measurement of Responses. The precise scales which have been developed to measure the events of the physical world must be applied in special ways to psychological events. The basic measurements of aspects of behavior are, of course, physical measurements. We count frequency of responses. We measure time intervals, speed, rate, amount, amplitude, intensity, and accuracy. For the more complex events of behavior, however, the psychologist has had to devise scales of his own on the basis

of which to interpret the validity and accuracy of his measurements. Such things as intelligence, personality characteristics, and attitudes can be evaluated only on psychological scales. The photographs in Figure 2.6 illustrate how procedures of measurement are applied to behavior.

Figure 2.6*a* shows a method for measuring *reaction time*. When the subject sees a light come on in the stimulus box, he lifts his hand from a metal plate. The elapsed interval, which has been timed electrically, is a measure of reaction time. In Figure 2.6*b* the subject is looking at a tilted circular plate, which appears elliptical, and is matching it to an equivalent ellipse on the strip of paper. His judgment of the appearance of the tilted plate varies with the brightness level and other factors.

Many investigations depend on the use of psychological tests. The Terman studies were based on the use of an intelligence test; the Minnesota starvation studies and the prison study used a personality test to measure characteristics of adjustment. The student in Figure 2.6*c* is performing a task in a widely used intelligence test for adults. The essential feature of psychological testing is to score individual performance according to standard rules, and then to compare the score with standards, or *norms*, which describe the performance of a large group of people on the same test. This comparison establishes the individual's performance with relation to the group. His score is either higher or lower than the average score. More precisely, his score can be described as being higher or lower than a certain percentage of the group. Thus this method of scaling is not based on a physical standard such as length or weight, but upon the way individuals vary within a group.

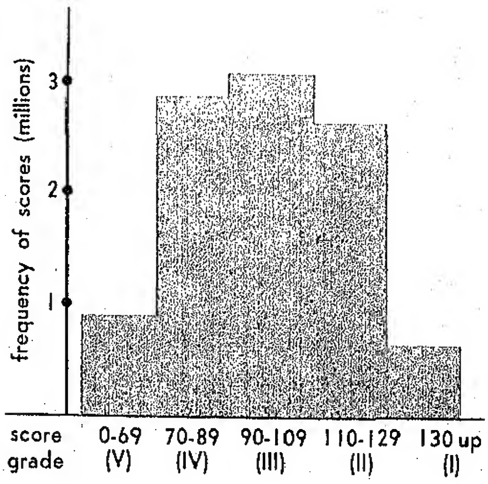


Figure 2.7. The frequency of scores of enlisted men in different grade levels of the Army General Classification Test in World War II. The vertical axis represents millions of men. Each bar represents the number of men who received scores in each grade level. The highest scores, 130 and above, were in Army Grade I; the lowest, up to and including 69, were in Army Grade V. (Data from Bingham, W. V. Inequalities in adult capacity—from military data. *Science*, 1946, **104**, 147–152.)

Distributions of Measurements. The reason we can use the differences among people as the basis for measurement of intelligence, personality, and many other behavioral characteristics is that people usually differ from each other in a regular and meaningful way. Some of the general features of the distribution of individual differences are shown in the bar graph, or *histogram*, in Figure 2.7, which shows the number of enlisted soldiers out of a total group of ten million whose scores fell within each of five grade levels on the Army General Classification Test (a type of intelligence test) in World War II.

The first general feature of this bar graph is that the scores are distributed; i.e., there is a range of scores from well below 69 to well above 130. This distribution of scores is an expression of individual differences—of the fact that not everyone makes the same score. The next feature we observe is that the score frequencies are smaller at the ends and larger in the middle of the distribution. This means that more individuals made scores between 90

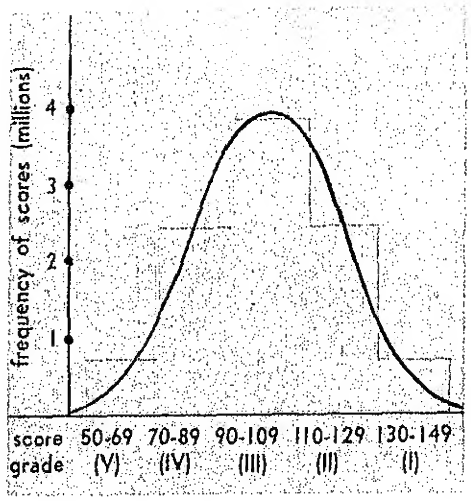


Figure 2.8. Predicted normal distribution of AGCT test scores shown in Figure 2.7. The bar graph shows the predicted number of scores falling in each grade level, superimposed upon a normal curve. (From Bingham, W. V. Inequalities in adult capacity—from military data. *Science*, 1946, 104, 147–152.)

and 109, Grade III, than in any other category. The fact that the most scores are near the center of the distribution is expressed by the concept of *central tendency.* If we wanted to choose a test score which would best represent the total group, we would choose one in Grade III, because this score range represents the greatest number of men.

Measures of central tendency. In choosing a number to represent the central tendency, we can use one of three procedures. We can pick the score which is the middle one of the entire ten million scores, which we call the *median.* Or, we can pick the score which more people made than any other, called the *mode.* The most commonly used procedure is to add up all the scores and divide this total by the number of scores to get the average, or *mean.* In the distribution pictured in Figure 2.7 and in many other distributions, all three measures of central tendency are very close together.

Another general feature of the distribution is its *symmetry.* You will notice that Bars I and V, and II and IV are approximately the same height, representing similar numbers of men. The numbers of men on each side of the center of the distribution are about equal. In a perfectly symmetrical distribution, the three measures of central tendency have the same value.

Normal distributions. The general features of the distribution in Figure 2.7 are characteristics of an idealized distribution known as the *normal distribution curve.* Distributions of height, weight, intelligence, and many other human characteristics follow, in general, the shape of the normal curve. Because this curve can be mathematically defined, its use allows us to make precise measurements of differences among people.

On the basis of the normal curve we can predict the distribution of scores which theoretically should occur in each of the five Army Grades. This predicted distribution is shown by the bar graph in Figure 2.8 along with the normal curve. It will be seen that the actual distribution in Figure 2.7 is not the same as the normal distribution in Figure 2.8. In the actual distribution there are too many scores in Grades II, IV, and V, and not enough in Grades I and III. The normal distribution is perfectly symmetrical while the actual distribution is not.

What accounts for these differences? One factor which influenced the distribution was the fact that only enlisted men were included. Officers and specialists who did not take the test and men exempt from military service might have changed the distribution. Other differences might be due to inadequacies in the test itself. Although psychological distributions are not identical with the normal curve, most of them resemble it closely enough to use its

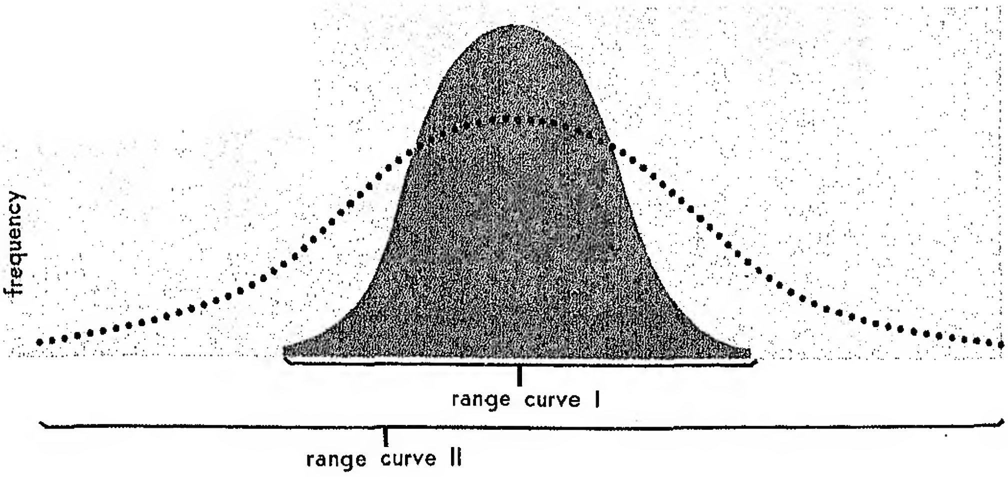


Figure 2.9. The shape of the normal distribution is determined by its mean and variability. Curve I represents a smaller range of scores than Curve II, and thus shows a more restricted distribution curve.

laws as a basis for measurement and comparison.

The shape of the normal curve is determined by two factors: the mean, or measure of central tendency, and a measure of the *variability* of the distribution. Figure 2.9 shows the influence of variability on the shape of the distribution. If we were to test the intelligence of two groups of people, and one group had scores very close to average while the other group included a larger proportion of people with very high and very low scores, the distributions of the scores might resemble the curves in Figure 2.9. Both distributions have the same mean, but they have different variability.

Measures of variability. A rough measure of the variability of a distribution is its *range*—the difference between its highest and lowest scores. In Figure 2.9, Curve II has a larger range than Curve I. A more precise mathematical description of a distribution's variability is the *standard deviation,* symbolized by the Greek letter sigma (σ). It is calculated by formula in terms of the differences between individual scores and the mean score.

$$\sigma = \sqrt{\frac{\Sigma (X - M)^2}{N}}$$

where

X = individual scores

M = mean

and

N = total number of scores

In the normal distribution of the soldiers' test scores, the mean is 100 and its standard deviation is 20. A knowledge of these two facts allows us to draw a normal curve like the one in Figure 2.10. Approximately 34 percent of the scores fall in the range from 100 to 120, one standard devia-

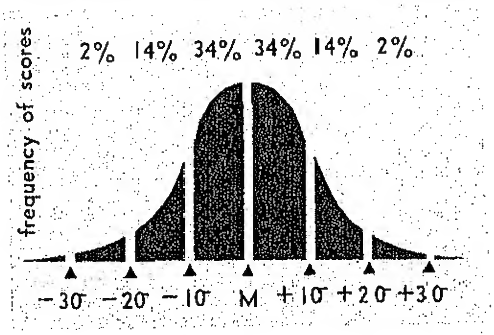


Figure 2.10. The normal distribution curve, showing the area falling within each standard deviation unit from the mean. Thirty-four percent of the scores in a normal distribution lie between the mean and one standard deviation above or below it, 14 percent lie between one and two standard deviations above or below the mean, and the rest lie more than two standard deviations away from the mean.

a

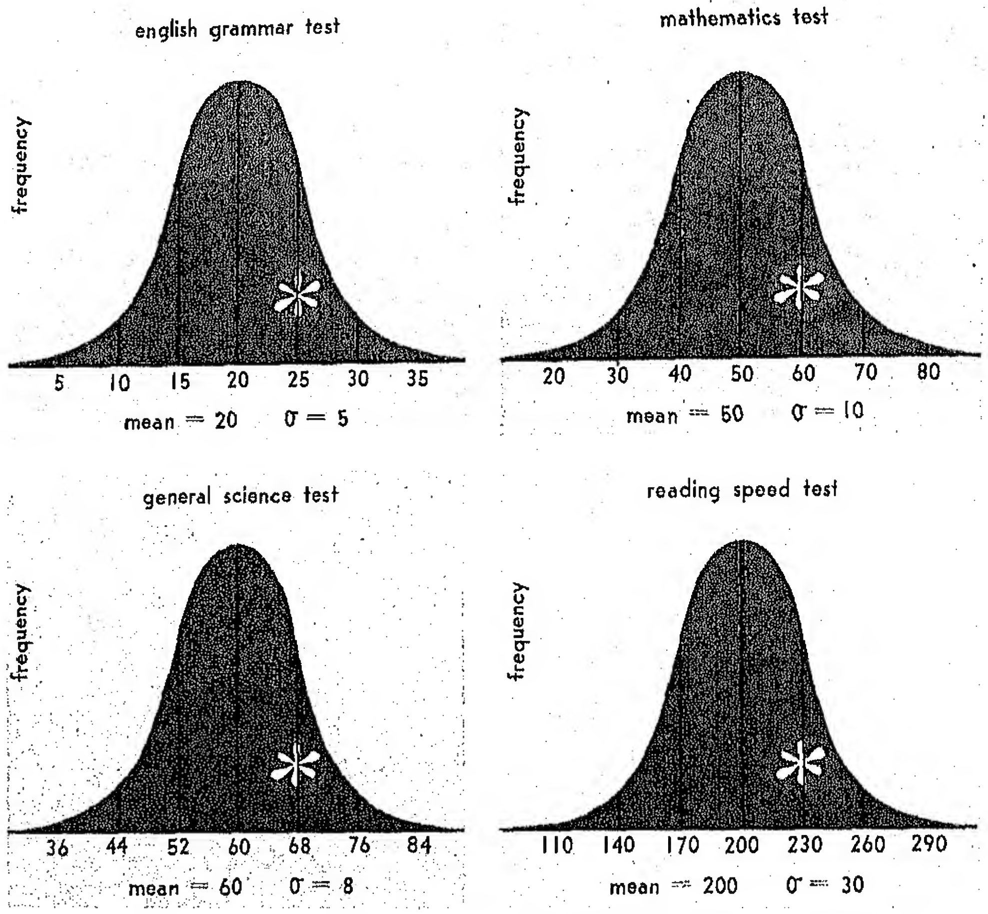


Figure 2.11. An individual's achievement scores in different tests can be compared if we determine his standing within a group. In this case the student made the same relative score on each of the four tests, with a standard score, or z-score, of +1 in each case.

b

test scores of john jones

test	raw score	z-score
english grammar	25	+1
mathematics	60	+1
general science	68	+1
reading speed	230	+1

tion above the mean, and another 34 percent fall in the range of one standard deviation below the mean. Scores between 120 and 140 (between one and two standard deviations above the mean) make up approximately 14 percent of the total frequency, as do scores between one and two standard deviations below the mean. Slightly over 2 percent of the cases are found more than two standard deviations above the mean and another 2 percent more than two standard deviations below the mean. We find 99.7 percent of the total frequency of the distribution within three

standard deviations on either side of the mean.

With this information, we can make precise statements about the scores of individuals on the test. We can say, for example, that an individual whose score is above 140 (two standard deviations above the mean) is in the highest 2 percent of the group tested, or we can say that 98 percent of the men in the sample scored below him.

We can also use standard deviation units to compare an individual's scores on several different tests. Suppose that all entering freshmen are given a series of tests which measure their knowledge of school subjects. We wish to find out how a certain freshman compares with his classmates on these tests. Figure 2.11*a* illustrates the distributions of four such tests. The center line represents the mean and the dotted lines indicate the division of the distribution in terms of its standard deviation. Note that the values of the mean and standard deviation for each test are different. However, we can express one student's scores on these tests in terms of standard deviation units above and below the mean. The table in Figure 2.11*b* shows a student's raw scores on the tests compared with his *standard scores*, or *z-scores*. His raw scores are all different, but when we locate each score in its own distribution, we find that they are all one standard deviation above the mean, expressed as a *z*-score of plus one. Thus the student's achievement scores on all four tests were the same in terms of his standing in his class.

Distributions which are not normal. We have seen that, when our measurements of a characteristic are distributed normally, the shape of the curve can be described by the mean and the standard deviation. However, some distributions of psychological characteristics are so different from the normal distribution that their analysis requires the use of special statistical procedures.

Figure 2.12 illustrates two types of distributions which cannot be considered normal. The curve pictured in Figure 2.12*a* is a *skewed* distribution, which means that it is not symmetrical. We say that this curve is skewed to the right, for from the point of the highest frequencies the distribution spreads out toward its right end while its left end drops more sharply. A teacher might get a skewed distribution of test scores from a class if he gave an easy test in which most of the students' scores piled up near the top limit. Figure 2.12*b* illustrates a *bimodal* distribution, distinguished by two modes, or two distinct points of high frequency. Distributions of this sort sometimes occur when we measure an ability in which some people have been trained and others have not. Measurement of typing speed might yield such a distribution, with untrained typists forming the mode at a lower level of speed and trained typists forming the mode at a higher level of speed.

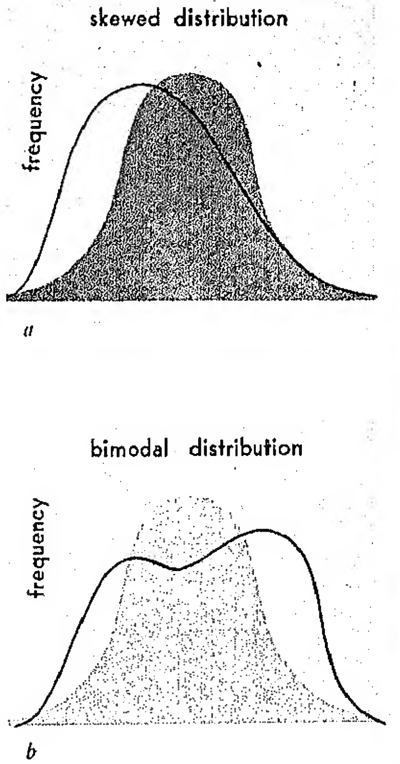


Figure 2.12. Two types of distribution which are not normal: a skewed distribution, a, *which is skewed to the right, and a bimodal distribution,* b. *The mean is not a good measure of central tendency in these distributions.*

Evaluation of Differences between Distributions. Our knowledge of the normal distribution not only allows us to make precise comparisons of individuals within the distribution, but also permits us to compare distributions of different groups of people. Let us suppose that we gave the same intelligence test to two groups of adults, one in an institution for the mentally retarded and the other a group of high school graduates. The distributions of the two groups might look something like those pictured in Figure 2.13*a*. Since

the distributions do not overlap—that is, since everyone in the high school group has a score higher than anyone in the mentally retarded group—we have no difficulty in stating positively that the groups differ in intelligence. We can describe the difference between the groups as a *mean difference* of 95 points, the difference between the two means.

The difference between most groups is not as pronounced as the one just described. Suppose we wished to determine whether college graduates were more intelligent than high school graduates. Many people who have not graduated from college are highly intelligent, and we would guess that at least some of the high school graduates would be as intelligent as many of the college graduates. Thus the distributions of the two groups would overlap, as shown in Figure 2.13*b*. We see that the group means differ by 20 points. How can we be sure that this 20-point difference between the means is not an accident, but is *statistically significant?*

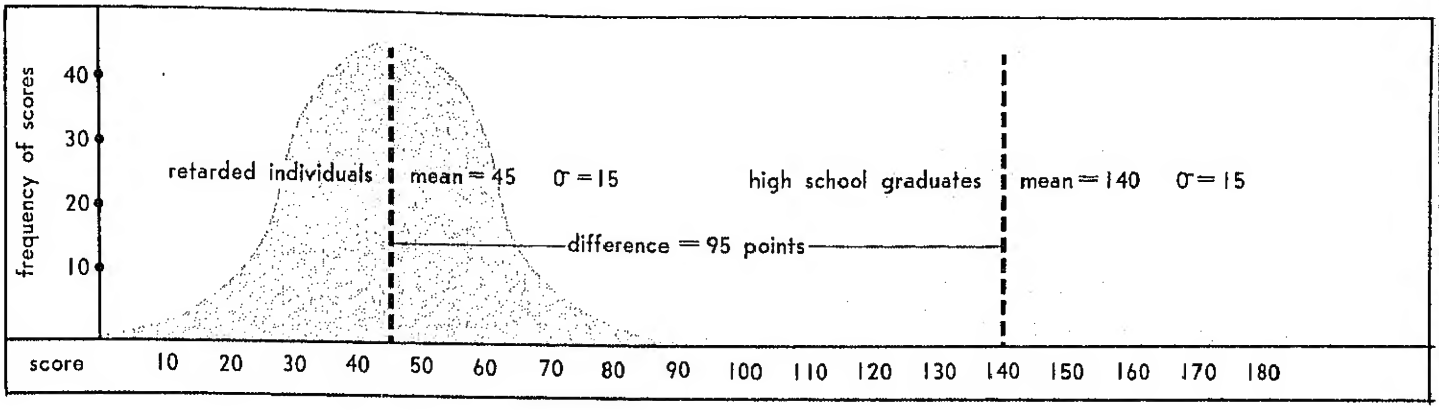
A statement of statistical significance is really a statement of mathematical probability. When we say that the means of two groups are not significantly different, we are saying that the difference might have occurred by chance. When we say that two means are significantly different, we are saying that the difference would occur by chance only in a small number of cases. There are standard criteria for determining significance. We usually say that a statistical measurement is significant if it occurs by chance only once in a hundred times, or even once in twenty times. To test the difference between the means in Figure 2.13*b*, we need to know both means, both standard deviations, and the *number* of people tested in each group. The more cases represented in the distributions, the more reliable the difference between them.

Chance differences in the measurements of two groups often occur. For example, Figure 2.13*c* pictures the distributions of intelligence test scores for college men and women, showing the men's mean score as two points lower than the women's. However, for groups of ordinary size the 2-point difference in the means would not be statistically significant. If the two groups were retested, the women might have a lower mean score than the men, or the two groups might have the same mean.

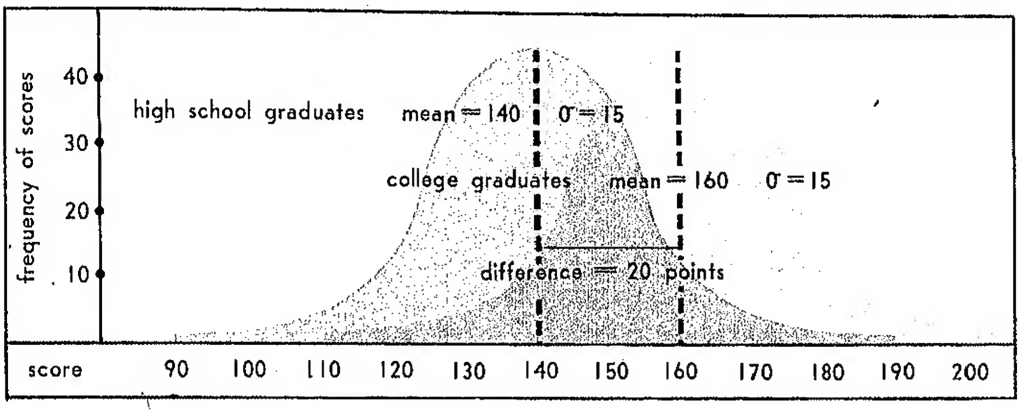
Relations between Measures. Many experiments measure the same characteristic of behavior in two different groups to determine the differences between the groups. But an equally important experimental procedure is to measure several characteristics of the same group to determine the relations among them. For example, we might be interested in the relation between intelligence and age, between personality traits and job success, or between the level of emotionality and motor performance.

Relations between different aspects of behavior can be studied in two ways. The controlled experiment is one way. We control and measure one variable, such as the amount of practice given in learning a task, and at the same time we measure the subjects' performance of the task. Thus it is possible to demonstrate that increased practice produces better performance or that, after a certain amount of practice, performance on a task no longer improves with increased practice. Similar procedures enable us to investigate all kinds of complicated relations in adjustive behavior.

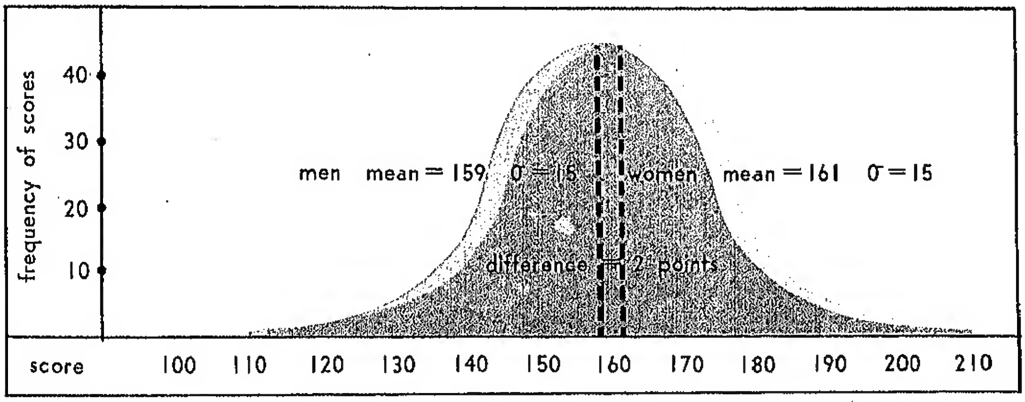
Another way to study relations between behavior variables is by the statistical tech-



a



b



c

Figure 2.13. Comparing differences between distributions. a. *When two distributions do not overlap, the difference between them is obviously "real" or significant.* b. and c. *When distributions overlap, the difference between their means can be tested for statistical significance in terms of how many times it would occur by chance.*

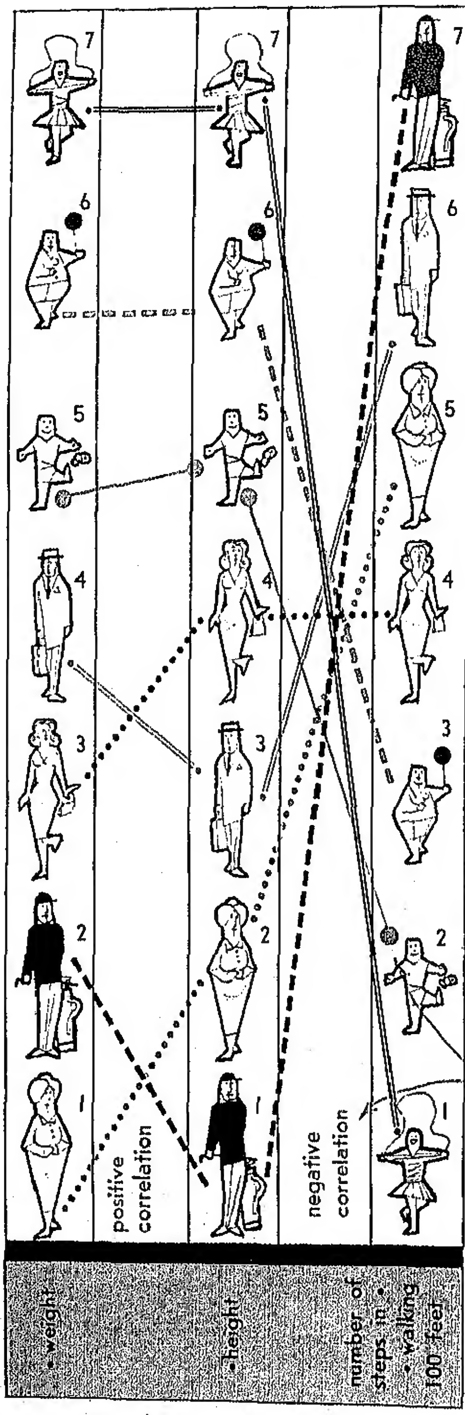


Figure 2.14. An illustration of positive and negative correlation. The seven individuals have been arranged according to weight in the left column, according to height in the center column, and according to the number of steps they take in walking 100 feet in the right column. Height correlates positively with weight, and negatively with number of steps in 100 feet.

nique of *correlation*. Correlation is a quantitative statement of the degree of relationship between two variables. It can be positive or negative, as shown in Figure 2.14. At the left side of the figure, a group of people are arranged according to weight, the heaviest person at the bottom and the lightest person at the top. To obtain a rough idea of the relation between weight and height, we will rearrange the same group of people in terms of their height, as in the center column. Although some shifts in the orders occur (indicated by the criss-crossed lines), in general heavier people are taller, indicating a positive relationship. On the right side of Figure 2.14, the same people are arranged according to the number of steps each person takes in walking 100 feet. The little girl at the bottom takes the most steps while the tall boy at the top takes the fewest. It is apparent that people with high scores for height have low scores for the number of steps; thus the measures of height and number of steps are negatively related, or show a negative correlation.

The degree of correlation between two measures is expressed by a correlation coefficient which can vary from +1.00, a *perfect positive correlation*, to −1.00, a perfect negative correlation. A correlation coefficient of 0.00 indicates that there is no relationship at all between the two measures. Correlations of +1.00 and −1.00 are rarely found in the measurements of relations between biological or psychological variables. For example, height and weight are not perfectly correlated because people differ in body build and amount of fat. Often a positive or negative correlation coefficient is obtained by chance when there is no "true" relationship between the variables measured. In general, the sta-

tistical significance of a correlation increases with the size of the group measured. A correlation coefficient is a special kind of numerical index which cannot be interpreted as an ordinary number. Thus, we do not say that a correlation of +.50 shows twice as much relationship as a correlation of +.25.

Correlation is an important measure in psychology because we use it for prediction purposes. If we know a person's high school grades, we can predict his performance in college. Our prediction may not be very accurate, because the correlation between these two factors is not perfect, but we can make a better guess than if we knew nothing of his high school record.

A statistically significant correlation between two variables does not tell us that one factor causes the other; it tells us only that there is a relation between them. Weight, for example, is not caused by height. Since events of behavior cannot be traced to a single cause, a high correlation *between two variables helps us to understand* the interplay of factors which influence behavior. Psychologists often express relationships among behavioral variables in terms of correlations, but rarely make any inferences about direct causation. Let us see why this is so.

CAUSATION OF BEHAVIOR

A single response of an individual cannot be traced to any one cause, but is the result of many factors interacting to produce a certain behavioral event. Thus two principles of the causation of behavior are *multiple causation* and *interaction*.

We often resort to simple answers to describe the causation of adjustment patterns in other people, particularly those patterns of which we disapprove. We say that laziness is the cause of failure, or that lack of will power leads to alcoholism. Studies of these behaviors indicate that *simple causes do not tell the whole story*. To understand why a behavior pattern occurs, it is necessary to study it, to identify the many factors associated with it, and to determine the interactions which produce it.

Multiple Causation in Adjustive Behavior. Two principles of multiple causation are illustrated in Figure 2.15. First, the same general response pattern may have many different causes, and, secondly, different response patterns may arise from the same general causative condition. The behavior which we describe as timidity may be traced to childhood training, repeated failure, or certain weakening illnesses (Fig. 2.15*a*). However, although continued failure produces timidity in one individual, in another the same sequence of failure may lead to angry aggression (Fig. 2.15*b*). *Different reactions involving widely different* body processes can result from the same general circumstances.

For an illustration of multiple causation, let us look at a study which was conducted in a foundry to determine the background factors related to the filing of grievances by workers. Two groups of men, those who had presented grievances and those who had not, were compared in an attempt to identify factors which differentiated grievers from nongrievers. No differences between the groups were found in wage level, age, height and weight, education, race, labor grade, credit standing, or total yearly earnings. However, nine factors were discovered which showed significant differences between the groups. Nongrievers were more often single, their starting pay

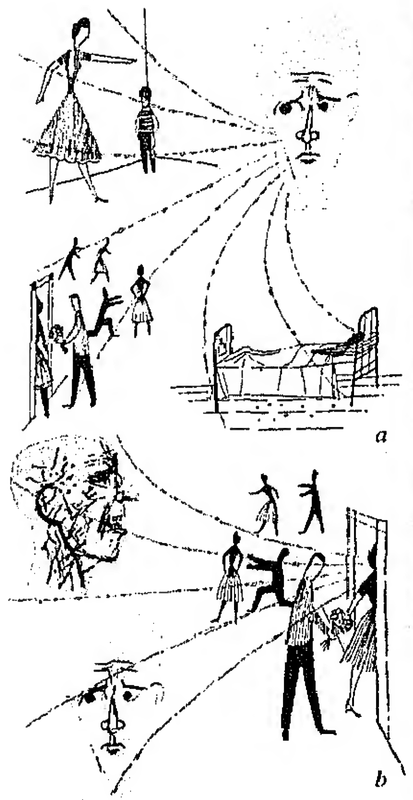


Figure 2.15. Multiple causation in patterns of behavior. The same pattern of behavior may be traced to several influencing factors, a, *or one influencing factor may give rise to different types of reaction,* b.

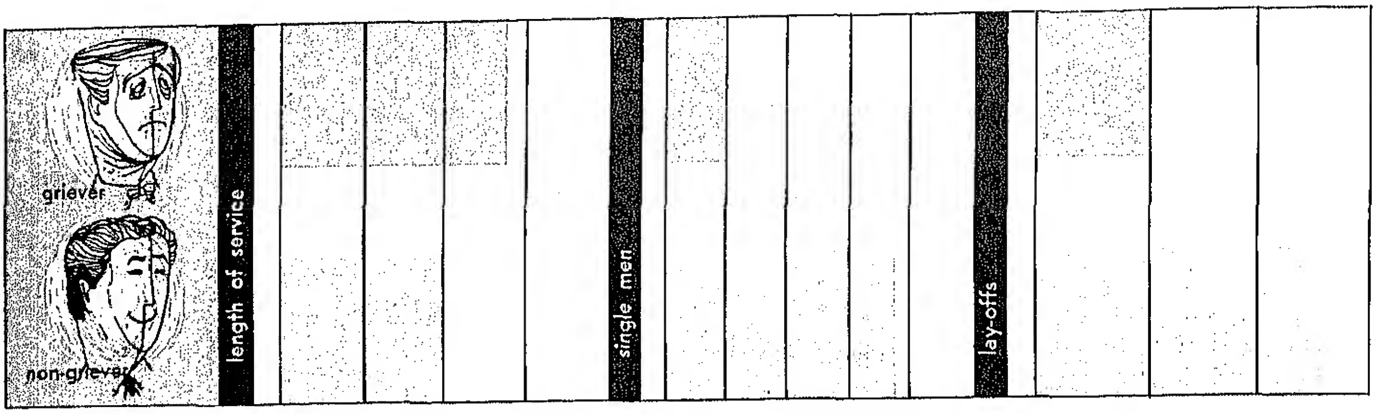


Figure 2.16. An attempt to identify differences between grievers and nongrievers in a foundry. Grievers had worked longer at their jobs than nongrievers; nongrievers were more often single and had been laid off more often. (Data from Eckerman, A. C. An analysis of grievances and aggrieved employees in a machine shop and foundry. *J. appl. Psychol.*, 1948, **32**, 255–269.)

was higher, and they had had more temporary layoffs than the grievers. On the other hand, grievers included a larger number of semiskilled workers; they had more children, had worked longer in the foundry, had been given larger wage increases, and had held more previous jobs than nongrievers. Some of these differences are shown in Figure 2.16. From these confusing results, it is apparent that a number of factors have more than a chance relation to grievance behavior, but the study cannot tell us that these are the only factors involved or that grievances in other industries would arise from the same factors. Complete knowledge of causation is probably never achieved.

A study of emotional reactions to combat-flying demonstrated that one general situation can produce many different reactions. Figure 2.17 indicates the frequency of various fear reactions described

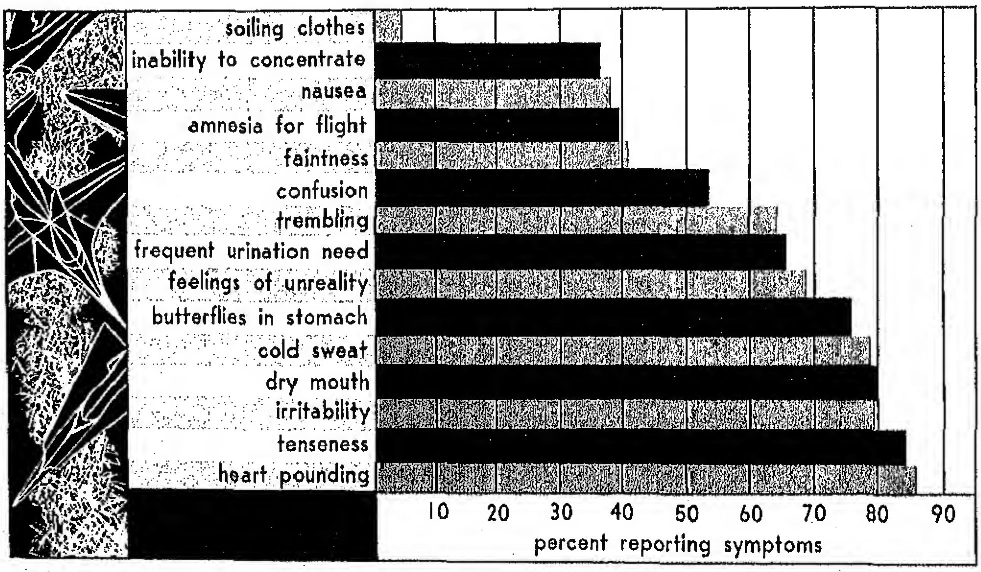


Figure 2.17. Percentage of combat flyers reporting different symptoms of fear during missions. The same general condition produced many different reactions. (Data from Shaffer, L. F. Fear and courage in aerial combat. *J. consult. Psychol.*, 1947, **11**, 137–143.)

by combat flyers interviewed when they returned from a mission. Reactions varied from mild states of emotion, evidenced by tenseness or a pounding heart, to very extreme fear with loss of sphincter control.

The multiple causes of behavior are both immediate and remote. Immediate causes include the stimuli presently acting on the individual and the present state of his bodily processes. Remote causes are such factors as childhood training, past illnesses, or previous experience in a similar situation, which have produced persisting changes in the body of the individual. Thus, present behavior is produced by an interaction of remote and immediate causes. This principle of interaction of determining factors should be examined at greater length.

Interaction of Factors in Adjustment. The numerous factors that determine the course of adjustment interact to produce a total effect quite different from the effect of any one of them acting alone. One way of expressing this idea is to say that the whole is different from the sum of all its parts, but this statement does not express the dynamic relationship that exists among the parts. Different patterns of behavior are likely to exert reciprocal influences on each other; that is, activity A influences activity B, which in turn changes the nature of activity A, so that something new emerges.

Three important forms of interaction in behavior are shown in Figure 2.18. The first of these, in which environment and reaction affect each other, is shown in Figure 2.18*a*. We may think of two types of change produced in the environment as a result of adjustive behavior. The first is a momentary altering of effective stimuli; e.g., if the girl blinks her eyes as she strikes the piece of sculpture, she cannot be stimulated for a moment by light. The second type of interaction leads to relatively permanent changes. Through behavior, man creates his own environment. The creations of society—the tools, the houses, the ships, the governments, and the languages—are aspects of the environment of man, fabricated by his behavior interacting with the physical world.

External reactions of the organism interact with physiological activity and behavioral processes inside the body (Fig. 2.18*b*). Hunger leads to the responses of eating, which, in turn, satisfy the body's

Figure 2.18. Forms of interaction in behavior. a. *The sculptress reacts to her environment and in so doing changes the nature of the environment.* b. *Overt reactions interact with inner emotional activities to change the course of behavior.* c. *In a behavior sequence, movements of different parts of the body affect each other and present movements influence the nature of succeeding movements, so that no one stimulus-response sequence is independent.*

a *b* *c*

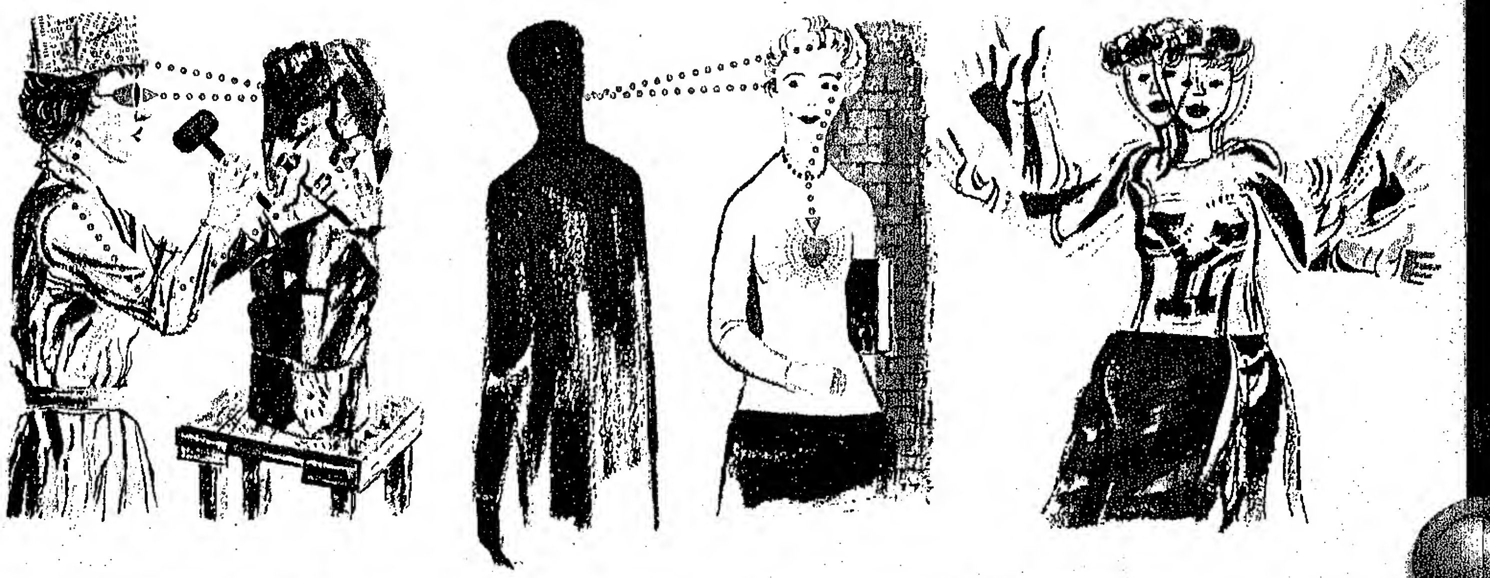
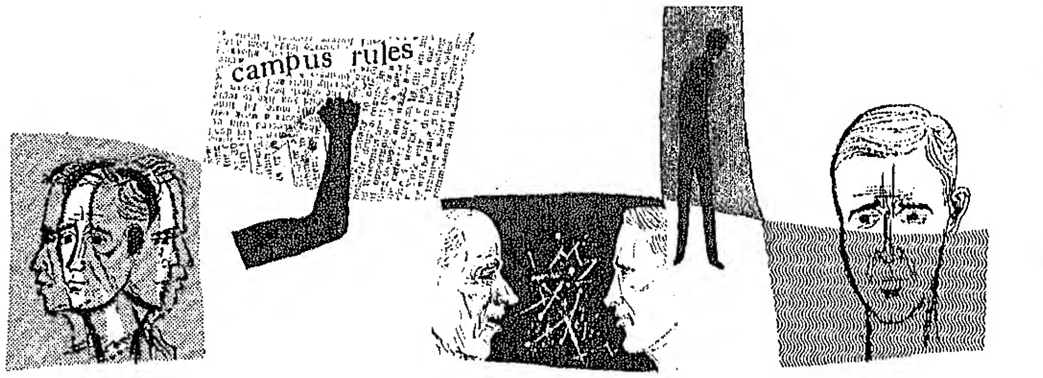


Figure 2.19. Problems of adjustment in college students can usually be traced to many interacting factors. Some of these factors are habitual indecision, antagonism to college authority, father conflict, depression, and restlessness.



need for food. Emotional response alters chemical activities going on in the body, leading to further changes in behavior.

In normal behavior, responses do not occur as isolated movements, but interact to produce coordinated patterns of response (Fig. 2.18c). In walking, the movement of one leg is coordinated with the movement of the other. Arm movements are coordinated with leg movements, speech movements with gestures, and movements of the head with postural movements of the body. Behavior is an integrated sequence of different movements of the body.

For a familiar example of behavioral interaction, let us turn once again to the college student who comes to the counseling center for help. He usually describes his problem in simple terms (low grades, poor social relations, etc.) and often attributes it to a single cause: a bad teacher, his roommate, or his inability to find a satisfactory course of study. The counselor soon discovers that many other factors enter the picture, some of which are described in Figure 2.19. Besides the factors illustrated, teachers, friends, housemothers, roommates, fraternity brothers or sorority sisters, college authorities, the social environment, and the cultural traditions of the school also influence the course of adjustment in the student. Although behavior is never simple, do we have any guiding principles by which we can hope to understand it?

CHARACTERISTICS OF ADJUSTIVE BEHAVIOR

A scientific conception of man has risen slowly out of the experimental study of behavior. Just as the physical sciences have changed theories about the universe and the atom, so the behavioral sciences are gradually altering our ideas of the individual as a social organism. We have advanced beyond the prescientific notion that human personality is animated by demons and spirits. We no longer find it necessary to believe that individual adjustment is guided by a mind or will over and above the human body. The science of psychology incorporates a number of general ideas which enable us to interpret detailed facts of behavior and to plan future studies. The individual is subject to many influences of a physical, biological, and social nature.

Adjustive behavior has many properties in relation to these different influences. The task of our science is to refine further the understanding of these characteristics to the end that behavior can be predicted and controlled.

At the beginning of the first chapter we said that psychology is the science of behavior. Now, after surveying some of the important problems, methods, and trends of thought in this field, we are ready to amplify that first statement. The summary of general characteristics in this section is the framework which gives meaning to the wealth of detail in later chapters. This, then, is what behavior is, and what psychology is about.

Behavior Is Motivated. Man is no rubber doll that squeaks when you press it. He reacts to external stimuli in terms of his own biological make-up, his behavioral past, and the particular state of his internal processes at the moment. Motivation is the energization of action, tying together body chemistry and internal behavior states with external action in the environment.

The human organism has a number of basic needs which must be satisfied if it is to survive. It needs food, water, and oxygen. It needs to maintain its temperature level and to eliminate its wastes. As an active energy system, the organism is motivated to maintain its physiological equilibrium.

The needs of man are not confined to the basic necessities for survival (Fig. 2.20). Motivation can also be seen in play activities and idle curiosity, in sexual behavior, and in all the learned drives related to social and economic goals. Its effects are as diverse as the actions of a hungry animal and the activities of an ambitious politician striving for high office. Motivation is the persistent activity of the organism which organizes behavior toward the end that its needs are satisfied.

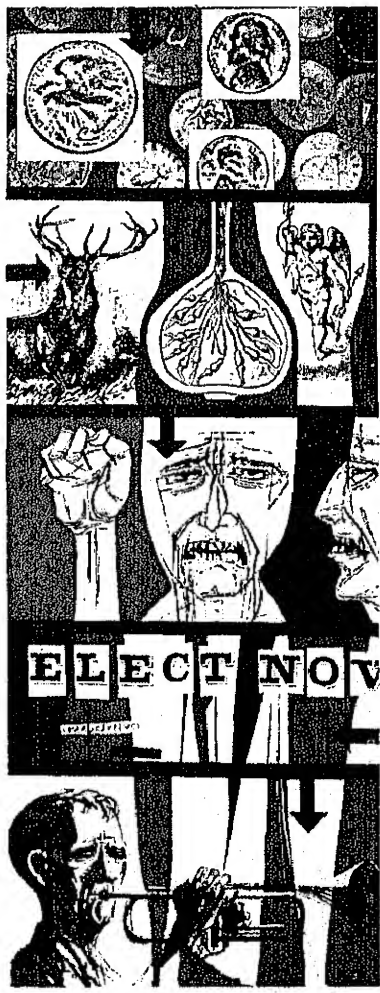
The pattern of motivation of the organism includes also those internal states accompanying emotion. Emotions serve as powerful motivating forces in their own right. The tensions arising in anger, hatred, and anxiety drive the individual toward actions which will bring release. Furthermore, emotional states interact with other drive states to modify the resulting motivated behavior.

Perceptual Organization. The individual knows the world he lives in only through the medium of his own perceptual processes. The physical universe is composed of nearly infinite variations and combinations of stimulating conditions—light, sound, heat, pressure, gravity, and chemical solutions. The individual does not receive these stimuli passively, nor does he observe his world in an indiscriminate or haphazard fashion. Through perceptual organization the living system brings order and meaning to the complex of physical stimuli which impinge upon it.

Our observations of the world are organized first of all in terms of the intrinsic nature of the perceptual processes. We do not see wavelengths of light—we see colors, forms, and space. The relationships we perceive between objects are not necessarily the "true" relationships, as described in physical terms. Perception is an active phase of behavior, in which the individual imposes his own patterns upon the world about him.

Perceptual organization is determined in part by the needs, emotional states, and past experiences of the observer. Figure

Figure 2.20. The motivation of human behavior takes many forms, from the satisfactions of the basic physiological needs of the body to all of the learned social and economic goals of the individual. Motivation is an expression of the persisting states of the organism that organize behavior toward certain ends.



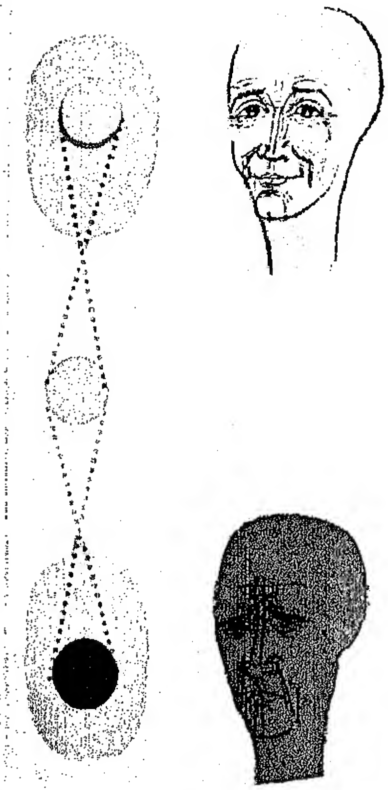


Figure 2.21. Perception of the external environment is determined by the structural and physiological make-up of the body as well as by the ongoing behavior pattern of the moment. The same external scene is perceived differently in different moods.

2.21 pictures the effect of emotion on perception. Black moods color the individual's observation of the world so that it is seen as threatening or unpleasant, while lighter moods bring out the "bright side." The same physical scene, literally, can appear different at different times because of the changing conditions within the individual.

Social Organization. Human nature is not fixed, immutable. It appears in the Australian aborigine and the atomic physicist, in the Tibetan monk and the Parisian street walker. Human nature shows many faces. The characteristics that are developed and those that are suppressed depend in large part on the social and cultural group into which the individual is born (Fig. 2.22). From the first, his behavior is molded by his social environment as truly as by his external and internal environments. The person he develops into—his pattern of adjustment, his personality—is, in part, a product of society.

None of the characteristics of behavior manifests itself independently of social influences. The motives that drive an individual reflect the attitudes, the beliefs, the customs, and the taboos of his culture and social groups. Ambitions for personal power or wealth are encouraged in some groups, frowned upon in others. Sexual drives are intensified in cultures which both inhibit and romanticize them. In cultures where sexual behavior is regarded as casually as eating or drinking, it poses no great problems of adjustment. In an easygoing society, emotional disturbances are not as frequent or as long lasting as in a high-powered, aggressive, individualistic culture. Learned behavior in the individual reflects the accumulated knowledge of his race and culture as well as of smaller social groups. The rate of learning is accelerated in a society which values precocity and achievement, decelerated where conformity is considered the highest good. Individual personality emerges in the interplay of physical stimuli, internal states, and social forces that determine behavior.

Change and Development. The living organism is never stable but is constantly changing throughout its lifetime. As the body structure grows and differentiates, there is a corresponding development of patterns of behavior. Later in life the processes of aging also influence behavior. Adjustment clearly is related to age and the physiological and psychological devel-

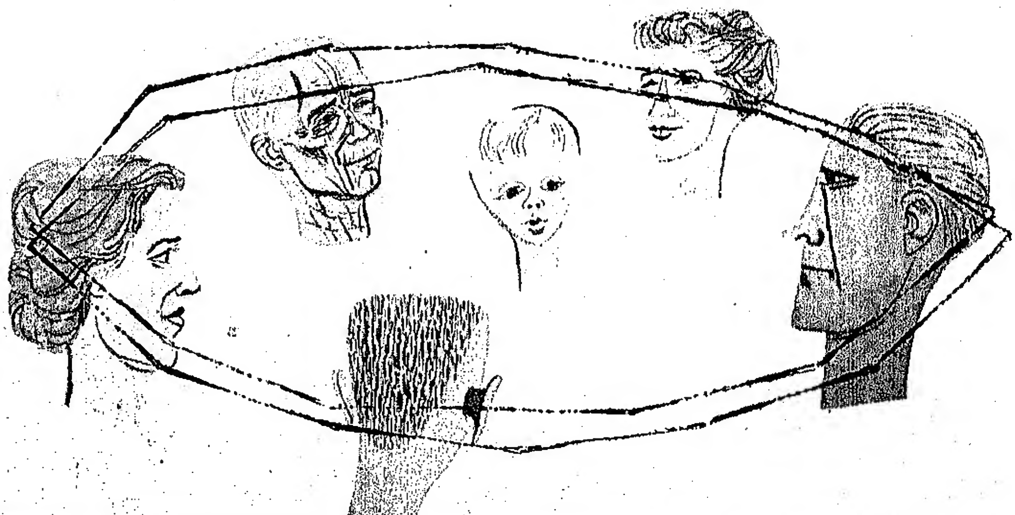


Figure 2.22. The human individual is molded from birth onward by his social environment. Some human characteristics are developed and some are suppressed according to the demands of social and cultural groups

opment of the individual. A major aspect of development is the process of learning—the means whereby activity is altered through specific reactions to the environment.

The individual's capacities for change make behavior subject to modification and control. Through our own efforts and through the efforts of others, our patterns of adjustment can be planned and regulated. To some extent, we hold the strings by means of which our own behavior can be influenced and fitted to the world about us (Fig. 2.23).

Individuality. Each of us starts life with a physiological and psychological organization different, within the limits of human variation, from that of any other person. During the course of development, the differences among individuals are likely to be intensified, each one working out his own life plan in terms of his hereditary endowment and personal behavior history. At any time in life the response given to a certain pattern of stimuli depends on the individual as much as on the stimuli. As we have seen, the same response in two persons may arise from different causes, and the same general cause may produce different responses. Attempts to control or change responses must take into account individual differences in behavior organization.

The concept of *personality* refers to the overall organization of adjustment in the individual at any one time. It is a kind of cross section of needs and drives, emotional reactions, and responses in every type of life situation, making up an organized pattern of behavior which is characteristic of the person. Personality also represents the stability of certain features of activity during the changes and modifications of adjustment. Although some responses change, the overall patterns retain an identity and appear to others as the distinguishing marks of personality.

The individual also observes this stability through change in himself. His private view of his own personality is his concept of *self*. Each person arrives at a notion of the self during the early years of childhood. The infant observes his own body, feels his own activities inside and out, and gradually differentiates his own physiological-psychological make-up from those he sees about him. "I" becomes different from "you" or "he" or "they," and lives forever in a world apart. The ability to think—to react to the environment in personal, private ways that need not be disclosed—contributes to the child's growing awareness of his own personality.

The public personality is not always the same as the private self. We try to "put our best foot forward," to present to the social world the kind of person we would like to be. As our own severest critics, we try to fit our actions to that ideal self which we strive for and never quite attain.

The Unity of Behavior. If we saw a child going past our house and asked "What is he doing?" the answer might take several forms. We might be told, for example, that the child is moving his legs up and down at such and such a rate, that his arms are swinging, and that his hands are clenched; meanwhile his heart is beating, his digestive organs are functioning, and he is perspiring; also he is seeing certain objects—trees, houses, people; he is hearing certain sounds—bells, voices; he is feeling pressures on the soles of his feet. We might be told all this, but probably not. In ordinary life the answer to our question would be,

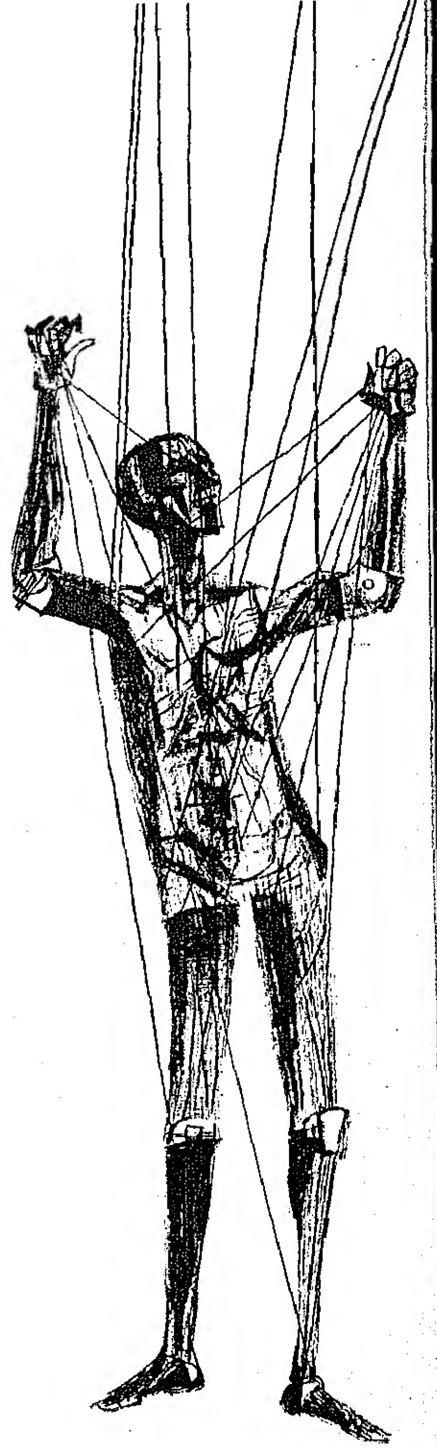


Figure 2.23.

"He is going to the store." Or, "He is running after his ball." Or, "He is looking for John."

Not that the first answer is not true. The information about the details of behavior is true enough, but it is not the sort of description in which we usually are interested.

Psychology, at one time or another, is interested in all levels of description of behavior. We shall learn that a knowledge of the organization of the details of behavior is basic to our understanding of the larger patterns. The various responses of the body are interrelated in the main pattern of behavior, the overall activity-in-progress. Motivation, emotion, perception, learning, and thought are not independent activities but different aspects of the integrated adjustment of the living organism.

SUMMARY

Behavior is adjustive response to the external, internal, and social environments. The aspects of the environment to which the individual responds are called stimuli.

General patterns of adjustment are organized around significant life situations. The same basic mechanisms underlie all the diverse modes of human adjustment.

Controlled psychological studies relate behavior patterns to many human and environmental variables. They have general, long-term significance because of their quantitative nature.

Psychology measures differences in behavior to establish quantitative relationships between measurable aspects of stimulation and response. In order to measure the more complex events of behavior, the psychologist devises his own tests and scales.

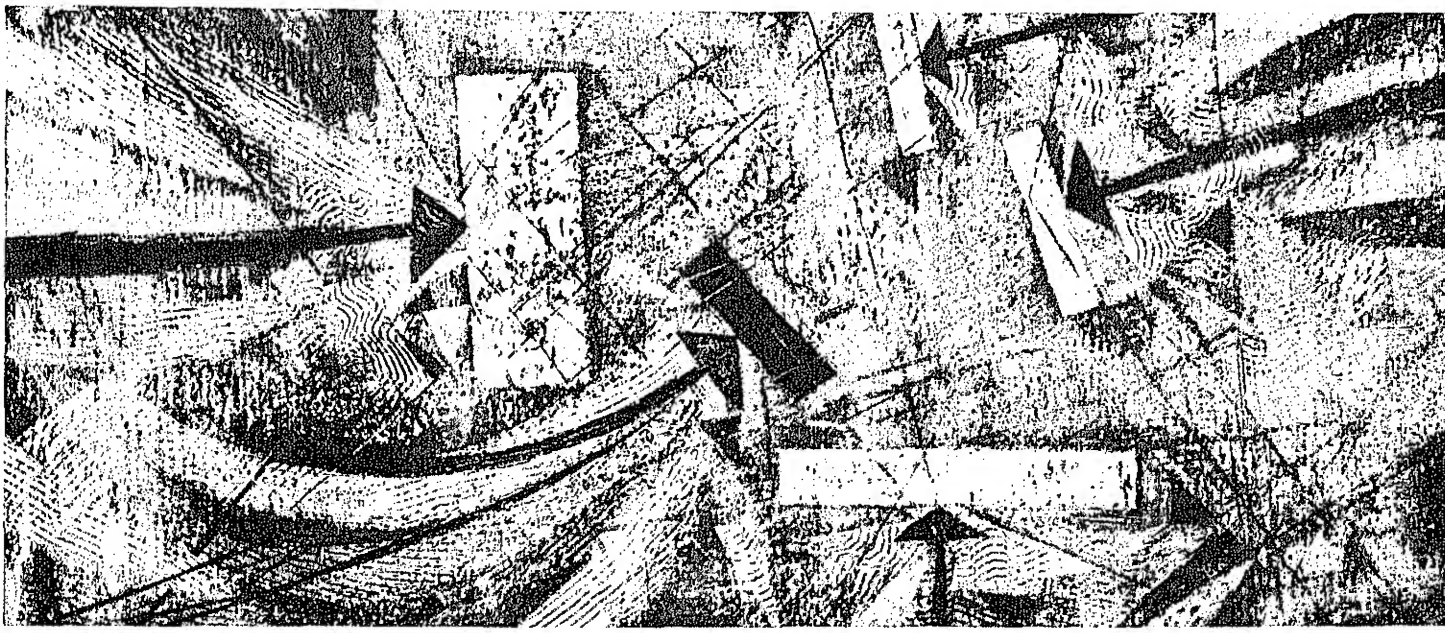
The idealized distribution of differences among individuals is expressed by the normal distribution curve, which is defined by the measure of central tendency called the mean and the measure of variability called the standard deviation.

Differences between groups of people are interpreted as being statistically significant according to the mathematical probability that the difference might have occurred by chance.

A quantitative statement of the degree of relationship between two variables is called a correlation coefficient, which can vary from $+1.00$ to -1.00. Measures of correlation are useful for prediction of related effects.

Patterns of behavior result from multiple causative factors which interact to influence the nature of adjustive responses.

Some general principles about the nature of behavior help us understand the detailed facts of the science of psychology.



CHAPTER 3. THE ORGANIZATION OF BEHAVIOR

One of the outstanding features of human adjustment is the diversity of forms it assumes among the people of the world. There are variations which are defined by general patterns of culture, and others which are imposed by conditions of the physical environment. However, many extreme forms of adjustment can be observed among people living in the same social and cultural group, under what appears to be the same general environmental conditions. What are some of the factors lying behind the diverse life patterns that are evolved? People differ, of course, in intelligence and other abilities, and in the opportunities they have had to learn different forms of behavior. But just as important as these factors, perhaps even more important in defining the general course of adjustment, is the motivational and emotional organization of an individual's behavior—what he strives for, what difficulties he encounters, and how he reacts to these difficulties.

Consider for a moment some extremes in human adjustment. There are the quiet folk, those placid individuals who endure little trouble, rarely exert themselves, cause no disturbance on the human scene. And then there are the fire eaters, the human storms, who create the drama of social living. On one side we see the timid, who avoid the challenges and dangers that come their way and, on the other, the individuals who live out their lives in the face of ex-

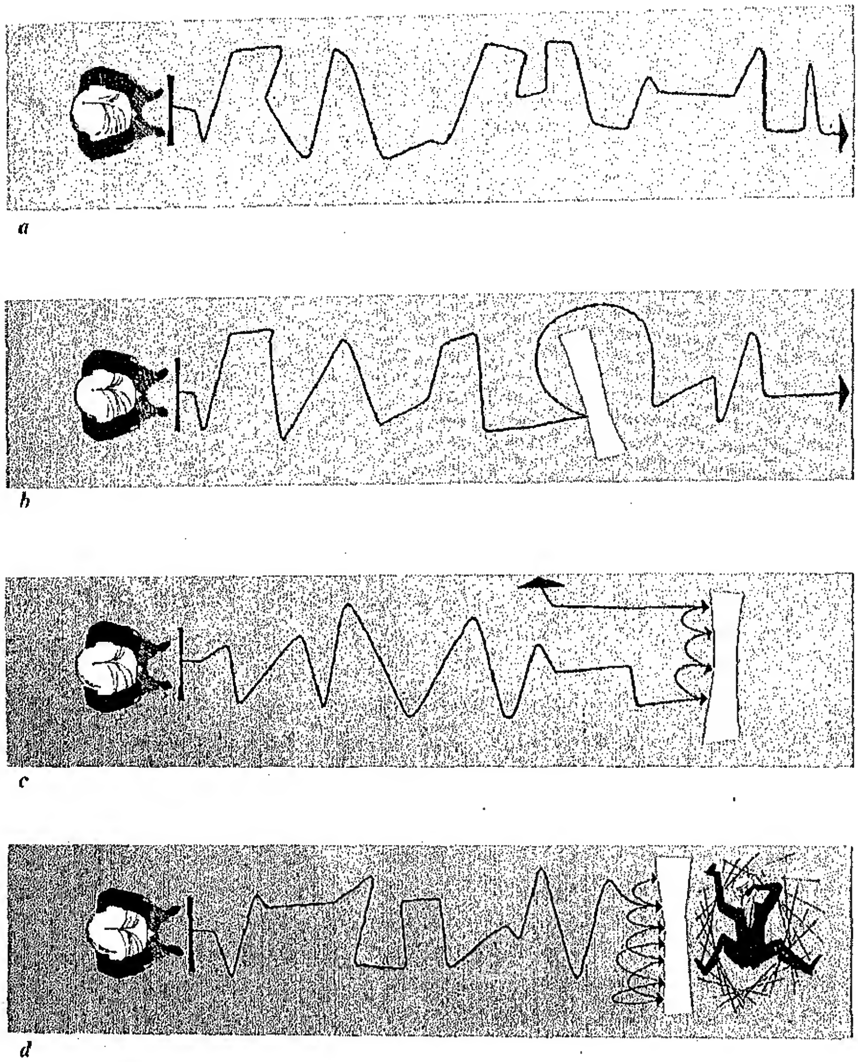


Figure 3.1. a. *Much of our routine behavior is uninterrupted and poses no great problems. When motivated behavior is blocked by an obstacle, the individual finds another way to his goal,* b; *changes the nature of his goal,* c; *or shows the disturbed, disorganized responses of frustration,* d.

treme stress and danger—in soldiering, coal mining, bridge building, and the like. At one extreme are the conformists, who would not dream of breaking a social, moral, or legal precept and, at the other, those for whom drunkenness is a way of life, burglary an hour's work, murder a job to be done. Can behavior be described so as to account for the common and the uncommon, the exception and the rule in human adjustment?

In this chapter we shall try to understand a form of behavior that is particularly important in organizing and reorganizing the course of adjustment. *Frustration* is a basic factor in human variability. It often leads to extreme change in the conduct of the individual, in the way he responds to his social environment, and in the way his life plan is worked out. When individual adjustive behavior is disrupted by frustration, the disturbance leads to the evolution of new patterns of response.

THE NATURE OF FRUSTRATION

We learned in Chapter 2 that one of the principal characteristics of behavior is that it is motivated or goal directed. Sometimes motivated behavior is blocked before it can achieve its goal. It can be blocked because of the absence or inadequacy of the goal itself, as when a hungry individual has no food available, or when a barrier, physical or psychological, prevents direct access to the goal. Or, behavior can be blocked when there are several alternate courses available and the individual must make a choice. Most of the routine of day-to-day living is uninterrupted behavior in which the individual applies learned responses to familiar situations. When blocking occurs, an element of *variability* is introduced.

Some of these forms of adjustive behavior are shown in Figure 3.1. At one extreme there is the uninterrupted flow of moment-to-moment action which makes up most of the behavior of our lives (Fig. 3.1*a*). The worker and the housewife perform their routine tasks in ways that have been familiar for years. The healthy child performs

hundreds of separate activities during the course of a day, passing from one to another in an untroubled and serene manner. There are no great challenges, no great problems, and little necessity for learning new forms of response.

However, when behavior is blocked by an obstacle, the individual is forced to vary his responses to find another way to the goal (Fig. 3.1*b*). A child finding his play obstructed by an adult moves about the barrier and proceeds with his behavior. The student faced with a problem he cannot solve in the usual manner goes about the solution in another way. The variable behavior of learning and problem solving is seen in every kind of life situation. The worker changes his methods and perfects skills through such variable behavior. The artist tries this and that combination of form and color to achieve what he wants in a picture. The young wife varies her purchasing habits to conform to the limited resources of her new husband.

Sometimes variable behavior is not effective in solving the problem, either because the individual is not highly motivated to achieve that particular objective, or because of his limited capacities for trying new forms of response. An obstacle which one person overcomes easily can effectively block another. In a case like this, an individual's goal may change. In Figure 3.1*c* the trial-and-error activity in the face of the barrier leads nowhere. Instead of persisting at his attempts to surmount the obstacle, the individual adopts a new line of activity and a substitute goal.

The forms of response which we have just examined usually go on without tension or agitation. When variability occurs, behavior is reorganized through learning, or flexible adjustments are made through substitution of goals. However, when the blocking of behavior induces emotional tension and disturbed behavior, we say that the individual is frustrated, that his behavior is a pattern of frustration.

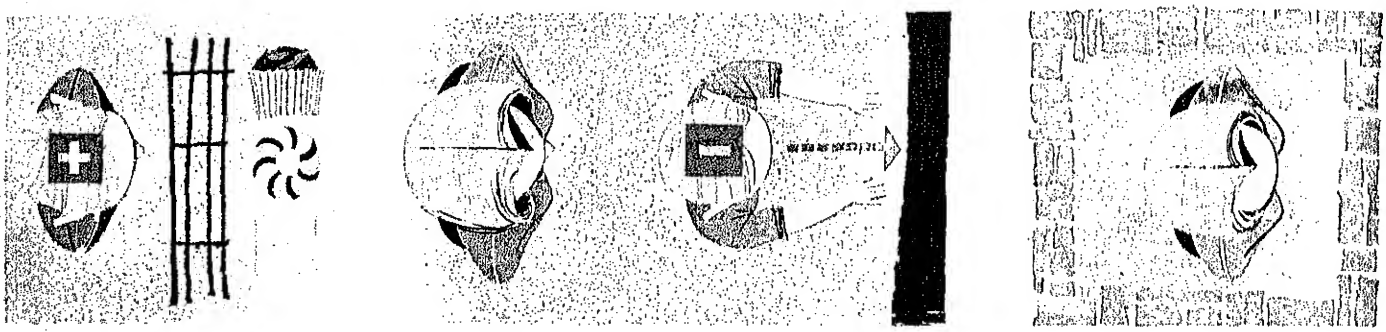
Suppose a student is hurrying to get to class on time and cannot find his notebook. There are several courses of action he can follow. A quick systematic search may locate the missing article. He may grab another notebook to use in place of the lost one, or go to class without one. We say that he is frustrated if the situation produces in him an unreasonable emotional disturbance, accompanied by a certain amount of disorganized activity unrelated to the original goal of getting to class. If he "blows his top," slams a book on the table, or flounces around in disgust, he is displaying the behavior of frustration. He may still solve his problem, in which case the frustration behavior gives way to more routine activity.

When a problem proves to be insolvable and the pressures on the individual are such that he cannot change his goals in good grace, his frustration may continue for some period of time. In Figure 3.1*d* we indicate a sustained frustration reaction. The individual finds himself blocked continually and does not find a substitute goal. He displays emotionally disturbed behavior —he "goes off the deep end."

Frustration Defined. The term "frustration" is widely used in psychology, but not always in the same way. It is sometimes used to refer to the situation which blocks motivated behavior. In the example above, the fact that the student cannot find his notebook would be the frustration, in the sense of a frustrating event. The term frustration is also used to indicate

the individual's emotional state of disturbance. In our usage we mean by frustration the pattern of behavior seen in an individual who has been blocked in his motivated activity. It is the *behavior* of the student who cannot find his notebook which we call frustration—not the blocking event and not the way he "feels" inside, but his whole pattern of emotional, disturbed, disorganized reactions.

In frustration the individual's goals are devious, often indistinct. The original goal may be lost sight of for a time in the necessity of dealing with emotional tensions. Blowing off steam is motivated by the anxiety of frustration, but does not usually advance the individual toward his original goal. Sustained frustration may be characterized by anxiety, irritability, fatigue, or depression. Normal patterns of behavior and even physiological functions are interrupted and changed in frustration. The subsequent reorganization involves both overt and implicit reactions.



a *b* *c*

Figure 3.2. Forms of blocking of motivated behavior. a. *A positive line of action, the child's attempt to get sweets, is blocked.* b. *The child is blocked in a negative line of action, an attempt to run away from his sister.* c. *Deprivation of some body need or learned demand constitutes a general blocking of activity.*

The Importance of Conflict. Frustration can occur in response to several kinds of blocking. Physical blocking occurs when we are held up in keeping an appointment by heavy traffic or by a train which blocks the roadway. Some obstacles are physiological or psychological, such as physical handicaps or inadequacies in skill or intelligence. But by far the most persistent forms of frustration are those caused by the clashing of motives and attitudes within the individual—the blocking brought about by *conflict*.

Think back to the four case studies in Chapter 2 dealing with problems of adjustment in college students. The young man with low aptitude for college work was blocked by a psychological obstacle, but the other three students were facing problems brought on by conflict of motives. One young woman was torn between her desire to be independent from home and family and her need to be approved and protected by her parents. Another wanted to hang on to her young man and yet felt guilty about yielding to his demands for sexual intimacies. The young man who wanted to be a coach was drawn to it by the nature of the work and repelled by the uncertainties and insecurities involved. Conflict is the old problem of whether to have your cake or eat it. A choice must be made, and the period of indecision may last from a moment to the best part of a lifetime.

SOURCES OF FRUSTRATION

Frustration is brought about by the interaction of at least two sources of stimulation. One of the sources can be within the individual and one outside, as when motivated behavior is blocked; or the two sources may lie essentially within the individual, as in conflict.

Forms of Blocking. Some of the forms of blocking which produce frustration are shown in Figure 3.2. A positive response can be blocked, such as the child's attempts to get sweets (Fig. 3.2*a*), or a negative response can be blocked, such as the child's attempt to run away from his sister (Fig. 3.2*b*). A cornered individual or animal may react in any one of a number of ways to thwarting conditions.

Frustration is much more likely to occur when behavior is blocked by other persons than by inanimate objects. For example, children are being halted continually in their activities, either physically or verbally, by those older persons who have the responsibility for their safety and for channeling their behavior into socially acceptable paths. The frustration brought on by physical blocking is not likely to be as severe or long-lasting as when it involves interpersonal relationships.

A third type of blocking is a general deprivation of a body need or requirement (Fig. 3.2*c*). The frustrated behavior of the very hungry individual or the sexually deprived person is not unlike that found in direct blocking by a barrier. In human adult life the motives most susceptible to frustration by deprivation are sexual, social, and economic motives. The nature of frustrated behavior during sustained thwarting of human needs is well known from studies of sex, of hunger, of thirst, of unemployment, and of solitary confinement. Although the pattern of behavior in these conditions varies, certain common features of frustration occur in all of them.

Forms of Conflict. The most severe and persistent frustrations are those that arise from the conflict of motives with respect to objects, people, or attitudes and beliefs. For example, the clashing of attitudes about sin with forms of social or sexual motivation can be the source of serious conflict.

The basic forms of conflict as defined by Lewin are diagrammed in Figure 3.3. They are *approach-avoidance* conflict, *approach-approach* conflict, and *avoidance-avoidance* conflict. The tendency to approach is indicated by a plus sign (+) and the tendency to avoid by a minus sign (−). Adolescents often show approach-avoidance conflict in relation to one or both parents. The girl in Figure 3.3*a* is drawn to her mother by habits of love, affection, and respect which have developed since infancy. At the same time she is repelled by newly discovered ideas that her mother is old-fashioned, dowdy, too strict, and in general an unsympathetic person.

Approach-approach conflict is known by every lucky person who has two or more good opportunities between which he must choose. The individual is motivated positively in two directions at once (Fig. 3.3*b*). Approach-approach conflict typically involves more factors than the two positive motives. When real frustration occurs in such a situation, the clash is between a positive direction of action and the desire to avoid hurting someone's feelings or losing some valued objective. Frustration induced by the presence of two promising

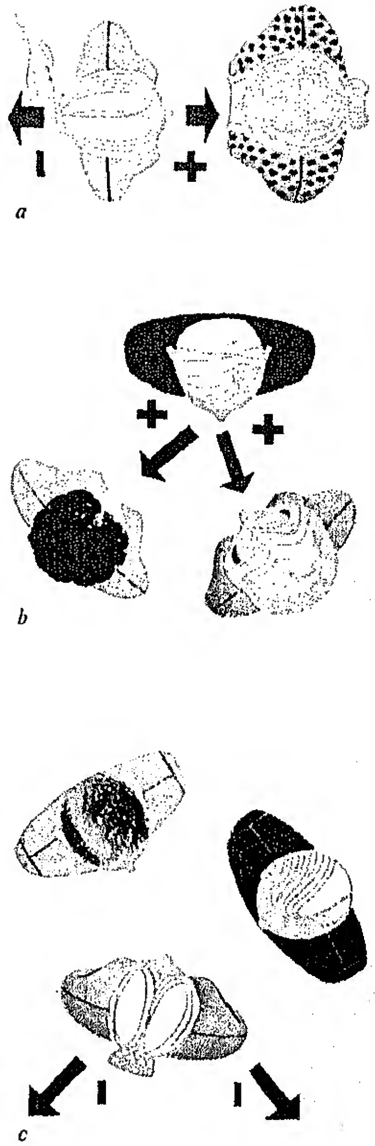


Figure 3.3. Forms of conflict
a. *Approach-avoidance.* b. *Approach-approach.* c. *Avoidance-avoidance.*
(Based on Lewin, K. *A dynamic theory of personality.* New York: McGraw-Hill, 1935.)

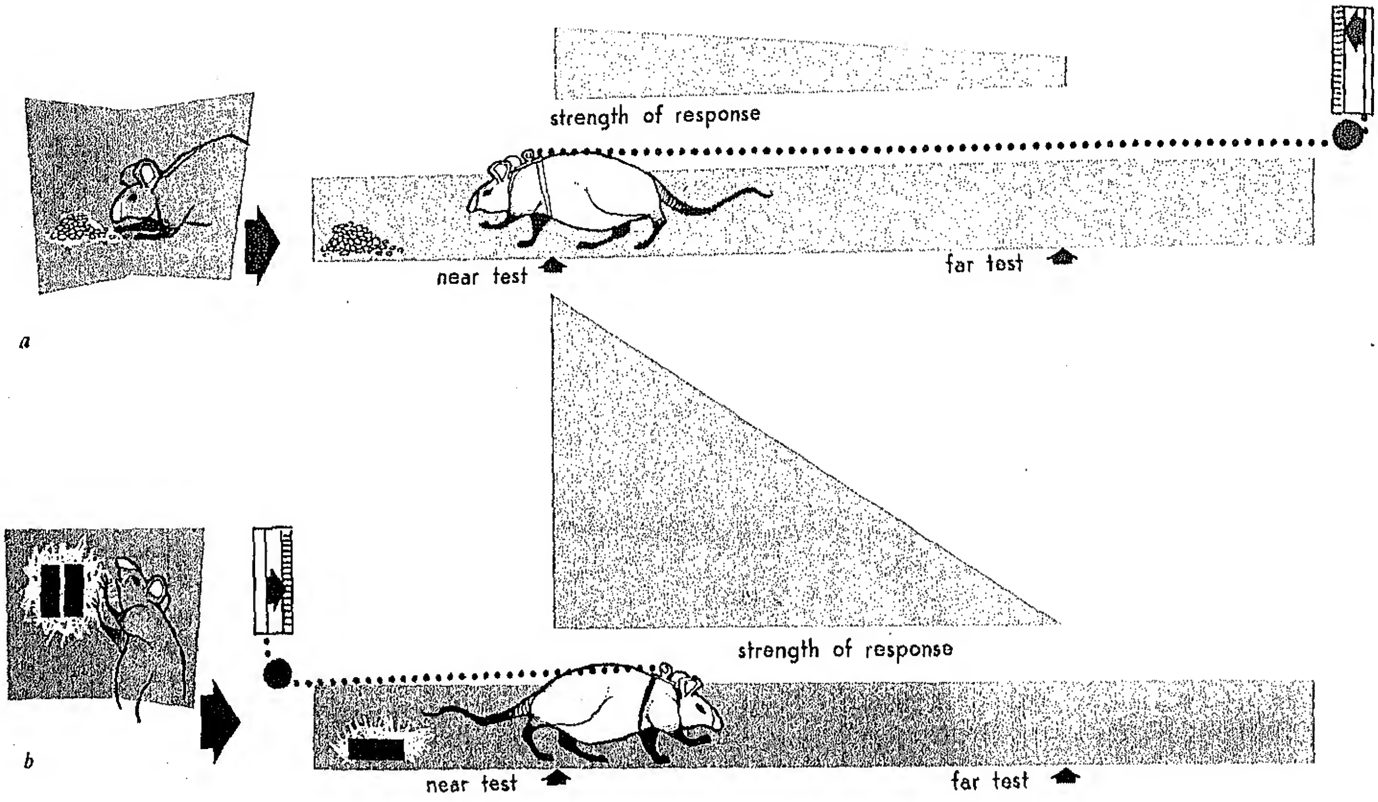


Figure 3.4. Gradients of approach and avoidance. a. *The slightly sloping line indicates the gradient of approach behavior, tested near and far from the food incentive.* b. *The steep slope indicates the gradient of avoidance behavior, tested near and far from the place where a shock was given.* (From Brown, J. S. Gradients of approach and avoidance responses and their relation to motivation. *J. comp. physiol. Psychol.*, 1948, 41, 450–465.)

goals is very like that of approach-avoidance conflict.

Avoidance-avoidance conflict (Fig. 3.3*c*) is like being between the devil and the deep blue sea, or being required to jump either into the frying pan or into the fire. A child is often threatened with unpleasant consequences if he does not perform an unpleasant duty. He must eat what is set before him, go to bed on time, stop his play to go to the bathroom, or take his punishment. The conflict state is often very serious because of the general blocking of activity coupled with the conflict situation.

An individual caught in an avoidance-avoidance conflict usually displays reactions of indecision or vacillation. The closer he approaches to one undesirable goal, the more repugnant it appears, and he swings back toward the other alternative. This second goal, in turn, becomes more repellent the closer it is approached. This variability in the strength of goals is described in terms of *gradients* of approach or avoidance. The state of indecision which is typical of avoidance-avoidance conflict is not as common or as pronounced in other forms of conflict.

Gradients of approach and avoidance. The effect of distance from a goal on approach and avoidance behavior has been demonstrated experimentally in rats. The rats in one group were trained to run down a runway in order to obtain food at the end. Those in another group were trained to avoid the end of the runway by

being given an electric shock there. In the second stage of the study, tests were made of the strength of the rats' approach or avoidance reactions. Each rat was fitted with a harness by means of which it could be temporarily restrained in the runway while the strength of its pull (toward the food or away from the shock) was measured and recorded. Each rat was given two tests, near the goal and far from the goal.

The results of this experiment are shown in Figure 3.4. The rats approaching food pulled harder, but only slightly harder, when they were near the food than at the other end of the runway. The difference in pull is represented by the *approach gradient* in Figure 3.4*a*, which rises slightly as the rat nears the food. The other rats, which had been shocked in the runway, showed a steep *avoidance gradient* (Fig. 3.4*b*). In this particular experiment the avoidance pull near the place of shock was very strong but was much weaker at the far end of the runway.

Conflict Situations. Conflict situations are almost as variable as human behavior, arising as they do in the clashing of any combination of human motives. There have been some attempts to explain conflict in terms of one or more primary types. Freud, for example, believed that most conflicts arise from the clashing of the sexual motive with social attitudes and beliefs. It is more realistic to describe conflict as a general psychological phenomenon. which can occur in relation to any strong motivation or goal-directed behavior.

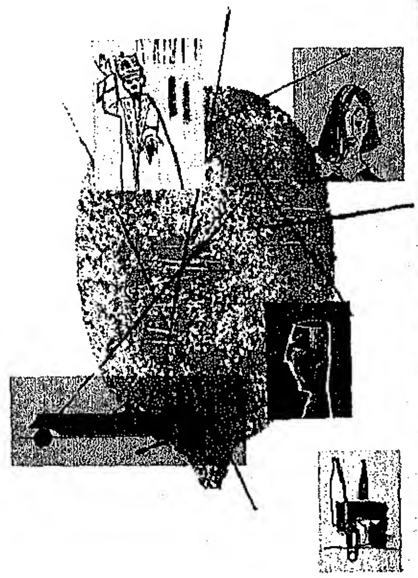
Although the source of conflict is within the individual, it is usually experienced as occurring between two life situations or two aspects of the same situation. The main channels of an individual's adjustive behavior provide the setting for his conflicts. These primary interests include home and family, sexual life, friends and social groups, community, work, hobbies, possessions, and ambitions. To one man, responsibility to his wife and children is of first importance, and any other interest which interferes with what he considers his primary duty can create disturbance and conflict. To another man, job and career are more important than family and friends.

In Figure 3.5 we show the outline of a person with different areas of conflict superimposed. Pictured here are five common types of human motives, sexual interests and drives, emotional fears and anxieties, social and convivial activities, motivation toward tangible goals—such as food, clothing, and luxuries—and intellectual and artistic interests and habits. Some of the clashes involving these motives are well known. A young woman finds her economic motives for tangible things clashing with her love interest in a poor, young teacher. Or, a student's anxieties about his capacities clash with his ambitions to enter into certain intellectual or social activities.

Some of our conflicts are organized in terms of verbal behavior, involving knowledge, attitudes, and beliefs based on language. Our verbal attitudes represent important parts of our lives. We argue about them and fight for them. Some of our attitudes are based on words or phrases that are almost meaningless in terms of our own life organization, yet conflict can arise just as surely in connection with a highly emotional, ill-defined phrase or slogan as with the strongest physiological drive.

We often have an ambivalent, or approach-avoidance attitude toward new knowledge. We value it for itself, yet reject

Figure 3.5. Areas of conflict in life situations. Any kind of motive can conflict with any other. Pictured here are motives related to sexual interests and drives, emotional fears and anxieties, social and convivial activities, tangible goals, and intellectual and artistic interests.



it if it contradicts our old familiar beliefs. Keep this in mind as you study the science of behavior. If you find yourself disturbed by some new idea concerning the nature of human conduct, try to understand the source of the conflict within yourself.

FRUSTRATION REACTIONS

Frustration occurs in both children and adults, and can also be observed in animals. It is typically of shorter duration in children than adults, although its manifestations may be even more striking in the young. We are going to examine some of the typical frustration reactions in children and adults, and then go on to experimental studies of frustration in animals and people.

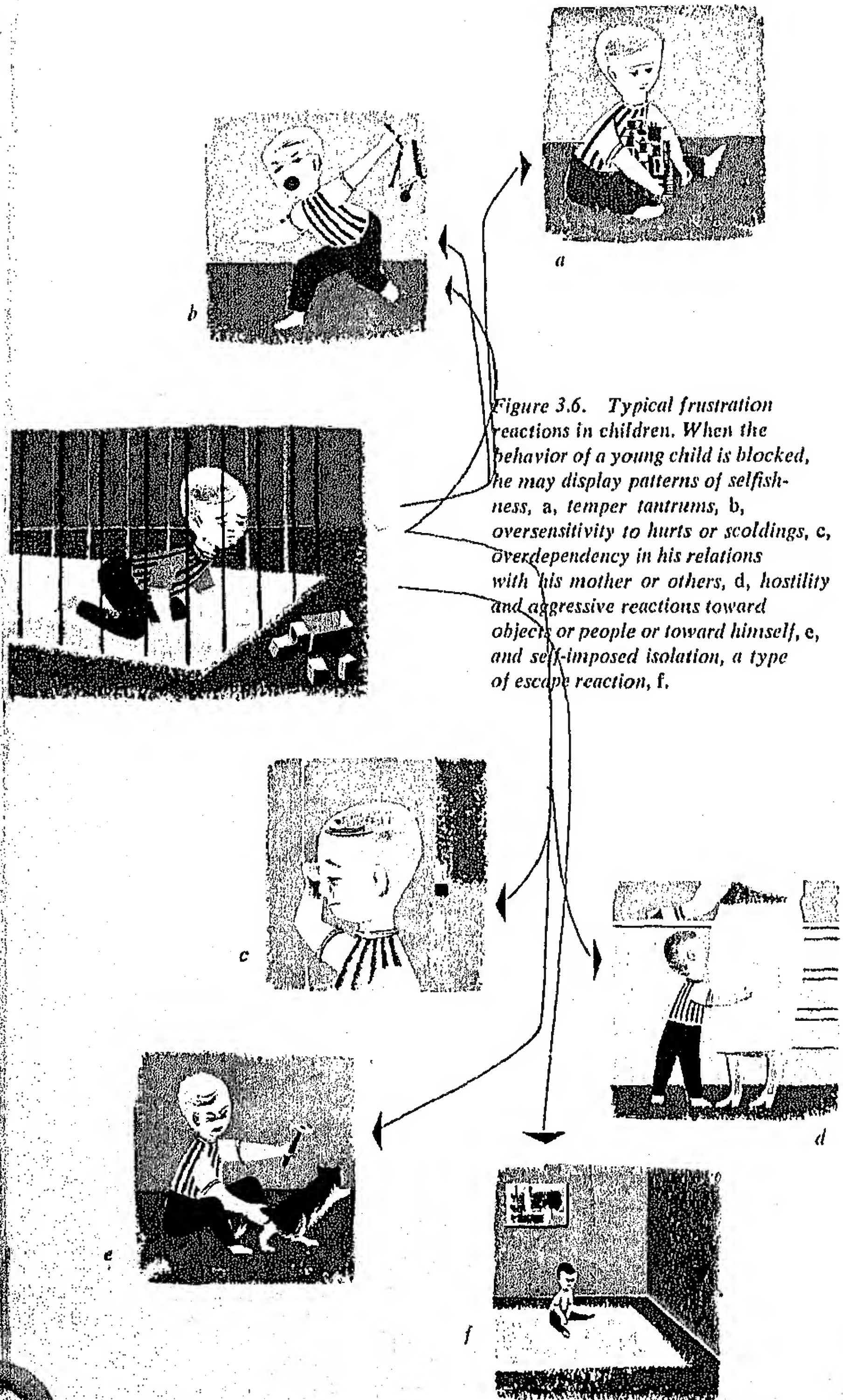


Figure 3.6. Typical frustration reactions in children. When the behavior of a young child is blocked, he may display patterns of selfishness, a, *temper tantrums,* b, *oversensitivity to hurts or scoldings,* c, *overdependency in his relations with his mother or others,* d, *hostility and aggressive reactions toward objects or people or toward himself,* e, *and self-imposed isolation, a type of escape reaction,* f.

Frustration in Children. Some of the behavior patterns displayed by young children in response to environmental blocking or conflict are shown in Figure 3.6. Anyone who has ever observed children will recognize these reactions. Selfishness (Fig. 3.6*a*) and temper tantrums (*b*) are common frustration patterns. Less well-recognized reactions are oversensitivity (*c*), overdependency (*d*), hostility (*e*), and self-imposed isolation (*f*).

Oversensitivity is a very frequent type of frustration behavior in the young child. He is easily hurt, either by minor injuries or harsh words. We see this behavior particularly in sibling rivalries, or in children who have been suppressed or verbally punished by parents. Overdependency is often related to sensitivity. The child tags after the parent, seeking special attention and protection. In prolonged overdependency the child delays learning to care for himself in dressing, eating, or sleeping alone.

Hostility and aggressive behavior are

seen in such common reactions as persisting anger, attempts to injure other children, destructive behavior, and competitive fighting. Adjustments of this sort are sometimes seen when a first child must adapt to a second baby in the family. Jealousy and self-destructive tendencies are still other expressions of hostility in the child.

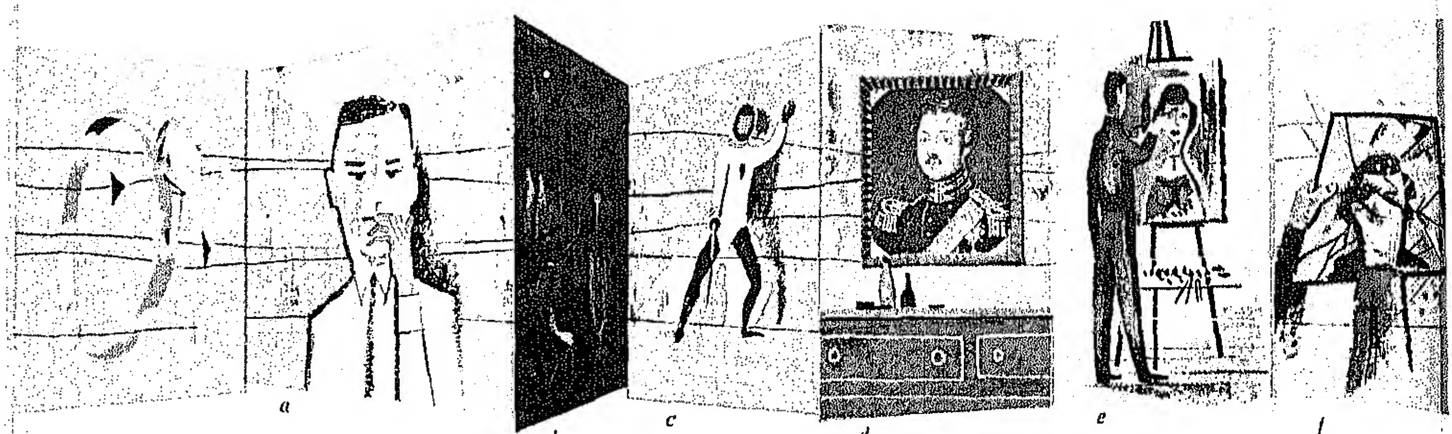
Isolation is a characteristic reaction of frustration. The spanked child runs off crying and screaming to stay in his room until the emotional disturbance subsides. He avoids the father who spanked him, as well as other members of the family, and anyone else who witnessed the scene. Isolation behavior combined with fears induced by frustration is seen as social timidity and backwardness.

The responses of frustration are not unusual forms of behavior in children. It is a rare child who can avoid blocking and conflict in his relations with other children and adults, and in learning the essential habits of social behavior. As the child grows older, his tolerance for blocking and conflict becomes greater and his ability to control these childish frustration reactions is generally increased.

Frustration in Adults. There is much overlapping in childish and adult frustration patterns. The behaviors described in Figure 3.6 are sometimes seen in adults, and the reaction patterns which we shall describe in this section are seen to some extent in children. There are probably some general differences in frustration behavior in children and adults, although these differences are not clearly established. Children often have more immediate outlets for wrought-up behavior in play and active fantasy than do adults. Furthermore, they are less restricted by long-established habit and social custom in their active expression of emotional troubles. Adult frustration is often more serious than that of the child, although even in children sustained frustration can involve marked psychological and physiological problems of adjustment.

As we have emphasized earlier, frustration is one of the most important aspects of adult behavior, in the sense that it disrupts established habit patterns and leads to reorganization of adjustive behavior. Descriptions of some of the reactions of adult frustration were first given by Freud, who interpreted them as expressions of unconscious motives in socially acceptable forms.[1] We shall first describe some of these reactions as they can be observed in ordinary behavior, and later show how these patterns of response have been investigated experimentally.

Primary reactions in frustration. The immediate reactions in frustration are in the nature of a general disturbance. The individual is likely to show anxiety, irritability, emotional tension, depression, and fatigue. An almost invariable component of frustration is anxiety, a state of fear and apprehension the basis of which may be completely unrecognized by the individual. Anxiety differs from direct fear of a dangerous or threatening situation in that it is sustained fear not directed toward a specific object. Along with anxiety, the individual shows heightened irritability; he is jumpy, excitable, and hypersensitive. Ordinary stimuli or interruptions may bother him a great deal. In this general state it is difficult, if not impossible, for him to relax or to sleep well. The frustrated individual is thus restless and unhappy. In sustained frustration, depression and fatigue may alternate with tension and anxiety.



a b c d e f

Figure 3.7. Some of the forms of substitute reactions of frustration. A young man whose engagement is broken by the girl may display stereotyped or fixated behavior, a, *fantasy and dreaming about his problem,* b, *compensatory activity, such as fencing,* c, *identification, or hero worship,* d, *sublimation, or a higher order expression of blocked motives,* e, *and displaced aggression,* f.

Substitute reactions in frustration. Marked frustration which cannot be resolved by solution of the conflict or motivational block typically leads to a number of substitute forms of behavior different from but related to the primary goal-directed behavior. These reactions are often complex and devious. Not only do they substitute for the original blocked goals, but they also furnish a means of release from the tensions and anxieties of frustration. Figure 3.7 describes six forms of substitute reaction which might occur in a young man who is in conflict over a broken engagement, signified by the broken ring.

Stereotyped or *fixated behavior* is shown as the tense habit of biting the finger nails (Fig. 3.7*a*). It is not uncommon for a frustrated individual to become rigid and compulsive in many activities in his daily schedule—in eating and drinking or in his modes of dress. Unimportant activities are sometimes emphasized and ritualized. In learning situations, especially in social situations which are related to the source of the frustration, stereotyped behavior seriously interferes with the acquisition of new forms of adjustment.

Frustration often includes *fantasy*—daydreaming and nightdreaming (Fig. 3.7*b*). Fantasy is imaginative activity in which the individual dreams of goals, of successes, or of overcoming obstacles. It serves as a substitute for actual success in achieving the blocked goal.

A common form of substitution reaction is known as *compensation.* We saw in Figure 3.1*c* how the blocking of a line of action can be resolved by redirecting behavior to another goal. Compensation is ordinarily somewhat more complex than simple substitution activity. Compensatory activity often symbolizes the blocked activity to the individual, even though he may not admit this to himself. A jilted suitor who marries "on the rebound" someone whom he does not particularly love is displaying symbolic compensation. Fencing as a compensatory activity (Fig. 3.7*c*) provides some expression of the original motive as well as relief from anxiety.

Very often, frustration coupled with a feeling of failure in one activity leads to a compensatory activity in which the individual can achieve some measure of success. In the case of the poor student who

substitutes success in athletics for failure in his studies, the compensation is a mode of adjustment not unlike nonfrustrated behavior. Then again, an individual may compensate for failure by identifying himself with an admired, successful personality. Hero worship, or *identification,* is shown in Figure 3.7*d*.

A form of compensation in which the individual substitutes childish or primitive modes of behavior for the frustrated activity is known as *regression*. Some examples are the types of reaction shown in Figure 3.6, such as temper tantrums, isolation, or overdependency. Another example is seen in the person who gets sick and goes to bed when things go wrong.

In contrast to regression, *sublimation* involves substitution of activities considered to be of a higher order than the blocked activity. It is an elevated expression of the original motive, sought in such activities as artistic or intellectual pursuits. There have been attempts to interpret the whole field of art as a general avenue for the sublimation of sexual urges or of anxieties related to sexual frustration. We need not follow this view in defining sublimation, for it is clear that art has many communicative aspects in addition to the individual motives and emotions expressed by the artist. Sublimation reactions may or may not be closely related to the original motive. In Figure 3.7*e* the young man takes up painting and reproduces the likeness of the girl whom he has lost.

The last frustration reaction in Figure 3.7 is that of *indirect* or *displaced aggression*. Direct aggression is a fighting response toward a threatening or dangerous situation. The displaced aggression of frustration is the same sort of reaction directed toward an object or situation different or remote from the source of the frustration. In Figure 3.7*f* the picture of the girl is the object of displaced aggression. In some cases the aggresive action is directed toward a person or object apparently bearing no relation to the source of frustration. For example, a housewife who has had a frustrating day nags at her husband and children. Or, a husband who would like to fight his boss comes home and quarrels with his wife.

There are several other forms of behavior often described as frustration reactions. In *repression,* the painful events connected with a conflict situation are forgotten. In psychoanalytic terms, the repressed experience is excluded from consciousness. Whether repression is a process that differs fundamentally from forgetting is a problem we shall take up in a later chapter. Another way of denying unsuccessful or unacceptable behavior is by *rationalization*—the giving of socially approved reasons for one's actions. Or an individual may deny his own failures by *projection*—that is, by attributing them to some other person. The young man who felt like a social failure because his girl broke their engagement might actually persuade himself that it was he who had cast her off. Still another expression of frustration is *reaction formation,* in which a person denies socially unacceptable motives by adopting the opposite attitudes, often in an extreme or fanatical way. For example, feelings of hostility may be replaced by extreme attitudes of affection.

These different types of frustration reaction are not mutually exclusive, nor do they represent a complete classification. As typical patterns of frustration, they represent modes of adjustment evolved by man and other animals to adapt to situations which block motivated behavior.

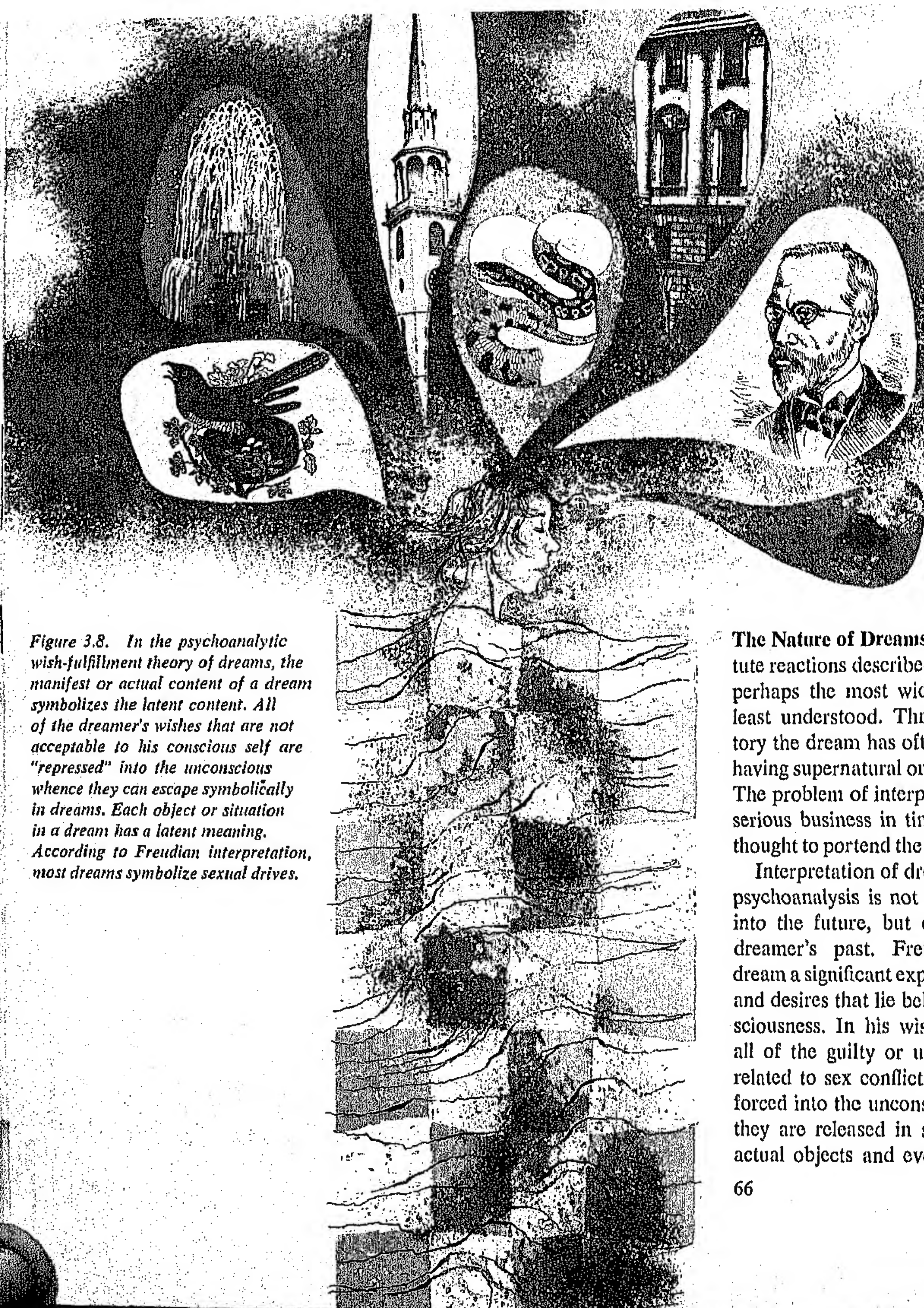


Figure 3.8. In the psychoanalytic wish-fulfillment theory of dreams, the manifest or actual content of a dream symbolizes the latent content. All of the dreamer's wishes that are not acceptable to his conscious self are "repressed" into the unconscious whence they can escape symbolically in dreams. Each object or situation in a dream has a latent meaning. According to Freudian interpretation, most dreams symbolize sexual drives.

The Nature of Dreams. Of all the substitute reactions described above, dreaming is perhaps the most widely recognized and least understood. Throughout man's history the dream has often been regarded as having supernatural or mystical properties. The problem of interpreting dreams was a serious business in times when they were thought to portend the future.

Interpretation of dreams in modern-day psychoanalysis is not a matter of looking into the future, but of probing into the dreamer's past. Freud considered the dream a significant expression of the wishes and desires that lie below the level of consciousness. In his wish-fulfillment theory all of the guilty or unpleasant memories related to sex conflict are "repressed," or forced into the unconscious. In the dream they are released in symbolic form. The actual objects and events of a dream, its

manifest content, do not tell the whole story. The meaning of the dream lies in its *latent* or *symbolic content,* which reveals the real wishes of the dreamer. Freud developed an elaborate system of interpretation of dreams, for he felt they revealed important characteristics of the individual and his problems.

The dreamer in Figure 3.8 illustrates the nature of dream symbols in the wish-fulfillment theory. Each of the manifest objects has a latent meaning. The professor in the dream might be interpreted as a father image, the bird as a little brother or sister. The other objects shown are usually interpreted as symbols of male and female sex organs.

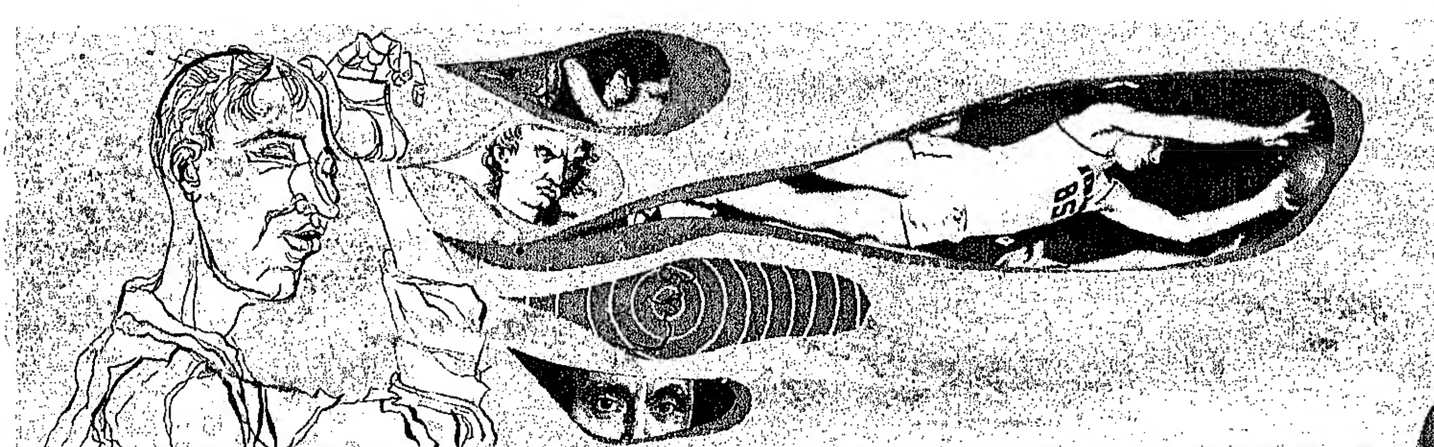
Although it is true that nightdreaming, as well as fantasy and daydreaming, is often a frustration reaction, this type of activity is very normal and not always a pattern of frustration. Furthermore, dreaming apparently can occur in relation to any problem or emotional disturbance and is not restricted to sex conflicts. For example, a starving man dreams of food, and a thirsty man of water. Whatever problems the day brings, whatever emotional disturbances or unresolved conflicts arise, can be carried over into related activities during sleep.

Objective investigations of the phenomenon of dreaming are so difficult that we have little to go on except interpretive observations. It is not possible to say how much of our dreaming activity represents frustration reactions and how much does not. One of the few systematic studies shows that dream activities vary considerably and appear to represent a wide range of normal behavior patterns (Fig. 3.9). In this study 10,000 dreams were reported and the actions performed by the dreamers classified into categories. Movement dreams accounted for about 34 percent of the total. A verbal category was next with 11 percent. Sedentary activity and visual behavior each included 7 percent, and antagonism 3 percent.

These observations and other objective data neither confirm nor deny the restricted psychoanalytic theory of dreams. They seem to suggest that dreams are an ongoing part of daily activity, which are motivated—as all activities are motivated—by many diverse needs.

Dreaming and fantasy should be considered as types of thinking activity, and we shall consider them from that point of view in a later chapter. At this point we want to emphasize that dreaming is a part of many different kinds of frustration, and understandably so. If a person has a difficult problem of any sort that he "can't get out of his mind," it is not surprising that he can't get it out of his dreams.

Figure 3.9. The action content of 10,000 dreams, classified with their percentages into movement dreams (34 percent), verbal (11 percent), sedentary (7 percent), visual (7 percent), antagonistic (3 percent), and several other categories. [From Hall, C. S. What people dream about. *Sci. Amer.*, 1951, **184** (5), 60–63.]



FRUSTRATION IN ANIMALS

Human frustration is one of the challenging problems of the behavioral sciences. Since Freud's original descriptions of this type of behavior in neurotic patients, there have been a sustained interest in the field and numerous speculations about the nature of frustration, the causative factors involved, and its role in adjustment. For many years, however, the only systematic observations on conflict and frustration were supplied by clinicians, who, for the most part, described the phenomena in nonobjective terms.

The last quarter century has seen a rapidly increasing interest in conflict, frustration, and anxiety as subjects of laboratory experiments in both animals and man. With the application of controlled methods of observation to these problems, our ideas about frustration are being refined and extended. The study of frustration in animals is of particular importance, since behavior patterns involving emotional disturbances can be studied in only limited ways with human subjects.

Frustration Anxiety in Dogs. Some animals taken into laboratories for use as subjects in experiments never adjust to the strange situation. They show all the emotional signs of strong anxiety—either depression or hyperactivity. Occasionally an animal refuses to eat in the experimental room.

This type of anxiety behavior was produced experimentally in dogs in a study illustrated in Figure 3.10. Fourteen dogs were habituated to being fed in an experimental room while harnessed in a stock with an adjustable wooden collar. The dog could reach food pellets which were dropped into the feeding dish, but could not move around. One of the dogs developed a feeding inhibition to the situation during training and consistently refused to eat there, but the other dogs adjusted to the situation. After this preliminary training, the dogs received a shock in the right forepaw at the moment they started to eat. After just one to four shocks they developed a feeding inhibition which lasted for weeks or even months without further shocking.

The anxiety behavior shown by the dogs was strikingly similar to some of the frustration reactions which we have described for human individuals. Some of the reac-

Figure 3.10. Frustration anxiety in dogs. Dogs trained to eat while harnessed in a stock were then given an electric shock at the moment they started to eat. They developed emotionally disturbed patterns of behavior very like human frustration behavior. (From Lichtenstein, P. E. Studies of anxiety: I. The production of a feeding inhibition in dogs. *J. comp. physiol. Psychol.*, 1950, 43, 16–29.)

tions observed were passivity or immobility in the experimental situation, struggle, resistance to entering the stock, tremors and disturbed breathing, ticlike movements (stereotyped behavior), vomiting in the presence of food pellets, refusal to eat in the living cage, increased aggression against cagemates, and general depression. This frustration behavior in dogs had both physiological and psychological aspects and carried over from the experimental situation to general adjustive behavior.

Reactions of Frustration in Rats. A number of experiments have been designed to produce in rats some of the more specific frustration patterns which occur in people. We are going to describe three studies which have demonstrated how displaced aggression, regression, and rigidity or fixated behavior can be induced experimentally.

The study described in Figure 3.11 has shown how patterns of aggression and displaced aggression are learned in a frustrating situation. White rats were put two at a time in a cage fitted with a grid for the floor (Fig. 3.11*a*). Through the grid they were given a slight electric shock, strong enough to keep them active. When the rats happened by chance to assume a fighting pose toward each other, the experimenter turned off the shock (Fig.3.11*b*). Thus the act of sparring or fighting was rewarded each time it occurred by escape from the shock. Rats readily learned to develop aggressive reactions as soon as the shock was turned on.

After the rats were well trained to fight in response to shock, a small doll was placed in the cage with each pair of rats. The rats continued to strike at each other and not at the doll. However, when a rat

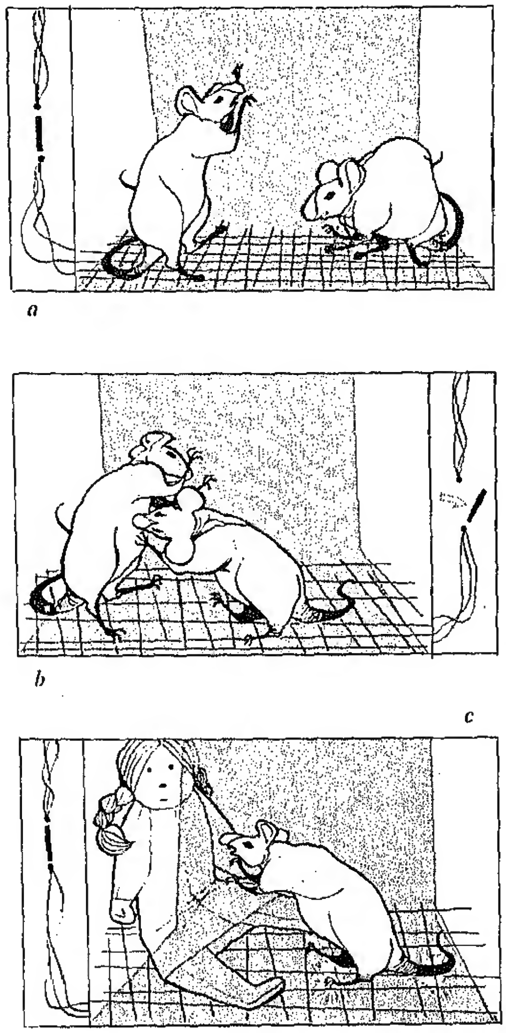


Figure 3.11. The development of displaced aggression. Rats given an electric shock in a box, a, *learned that they could escape the shock by fighting with each other,* b. *If another rat was not present, the aggressive behavior was displaced toward a doll,* c. (From Miller, N. E. Theory and experiment relating psychoanalytic displacement to stimulus-response generalization. *J. abnorm. soc. Psychol.*, 1948, **43**, 155–178.)

was placed in the cage alone with the doll and the shock was turned on, it struck at the doll. This displaced aggression was a form of adjustment not unlike the young man's cutting up his girl's picture.

Another well-known experiment describes the development of a pattern of behavior in the rat very much like human regression. The apparatus used in this study was an enclosed cage with a grill floor

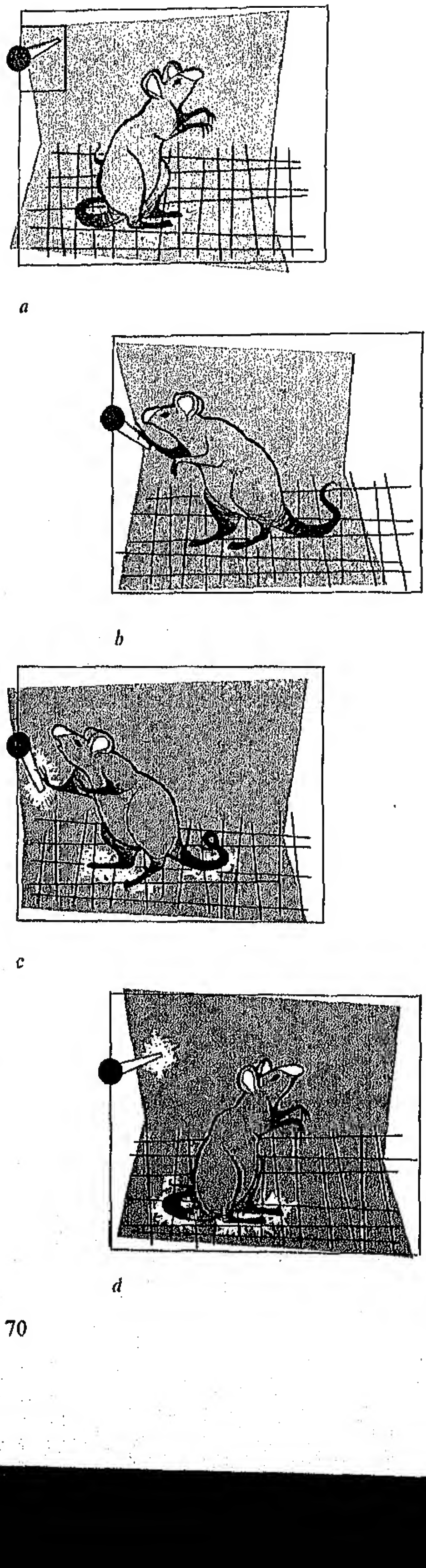


Figure 3.12. Experimental regression in rats. Put into a cage where they were shocked through the floor, rats learned to sit up on their haunches to minimize the shock, a. *Later they learned to push a pedal to turn off the shock,* b. *When they also received a shock through the pedal,* c, *they regressed to their first learned habit,* d. (From Mowrer, O. H. An experimental analogue of "regression" with incidental observations on "reaction-formation." *J. abnorm. soc. Psychol.*, 1940, **35**, 56–87.)

through which an electric shock could be introduced. The shock started at zero intensity and gradually built up to a level strong enough to cause agitation in a rat. On the wall of the cage was a pedal which, when it was pushed, would cause the shock to drop to zero. As soon as the pedal was released, the shock again started to build up.

A control group of rats, introduced one at a time into this cage, rather quickly learned the use of the pedal. Their first trial was characterized by enough random activity to cause them to strike the pedal by chance and turn off the shock. Thereafter these rats were inclined to stay at the pedal end of the cage and soon learned to "freeze" in position in front of the pedal, ready to strike it as soon as they again felt the shock.

The experimental rats were treated somewhat differently (Fig. 3.12). They were put in the cage one at a time, but the pedal was covered so that there was no way to turn off the shock. Once a day for six days they had to remain in the cage for fifteen minutes with the shock on. These rats all learned that if they sat quietly on their hind legs, holding up their forepaws, they received comparatively little shock. This reaction, Habit A, is shown in Figure 3.12*a*. After the six days' training in Habit A, the cover was removed from the lever and these rats learned the pedal-pushing response, Habit B (Fig. 3.12*b*). They did not learn as rapidly as the control group, since Habit A was strong enough to interfere with random activity. In some cases the rats had to be prodded into moving about. However, within three days they were quite as adept at pedal pushing as the control group.

At this point both groups of rats received

an even ruder shock. When they pressed the pedal to escape from the grill shock, they received another slight shock from the pedal (Fig. 3.12*c*). Thus they were placed in a conflict situation. In order to stop the increasing shock through the grill, they had to submit to a momentary shock through the pedal. The rats in the control group, which had never learned anything but Habit B, continued to use it. That is, they endured the pedal shock in order to escape the grill shock. Four out of the five experimental rats, however, gave up Habit B and "regressed" to Habit A, as shown in Figure 3.12*d*. They reacted to conflict by using a previously learned behavior pattern instead of continuing with the more recently learned habit. The control rats had no habit to "regress" to in the situation.

Another study demonstrated how a problem situation which produced conflict led to rigid or fixated reactions. The rats in this experiment were faced with an insolvable problem (Fig. 3.13*a*). They were forced to jump from a small platform toward one of two apertures covered with cards. One card had a black circle on a white background, and the other a white circle on black. One card was always unlatched, so that if the rat jumped against it, it fell back and the animal landed on a small platform where it was fed. The other card was latched securely, so that if the rat jumped toward that one, it received a bump on the nose and fell to the floor. The cards were alternated back and forth in a random manner and were also latched in a random manner, so that there was no way of determining which way to jump. No matter whether it jumped toward a certain card or a certain position, the rat was punished half of the time and rewarded half of the time. In this situation the rats developed position habits, jumping toward one side or the other.

The rat shown in Figure 3.13*b* always jumped toward the right. This learned response served as a partial adjustment to the conflict situation. After this habit had developed, the card in the left aperture was removed and food was placed there, freely accessible (Fig. 3.13*c*). The rat persisted in jumping to the right, even though that resulted in its falling to the floor. The fixated behavior which it developed in frustration persisted to such an extent that it interfered with the easy solution of a new problem. We sometimes see fixated behavior in human individuals which appears just as stupid as this rat's fixation unless we can understand it in terms of the frustration that produced it.

These descriptive studies of frustration are important both for their methods and their results. They show us that frustration has a broad scope in animal behavior. They enable us to define more exactly some of the reactions related to blocking and conflict about which there has been so much speculation. The animal experiments lay the groundwork for systematic investigation of the bodily mechanisms of frustration and of the effects of stress and frustration in the development of adjustive behavior.

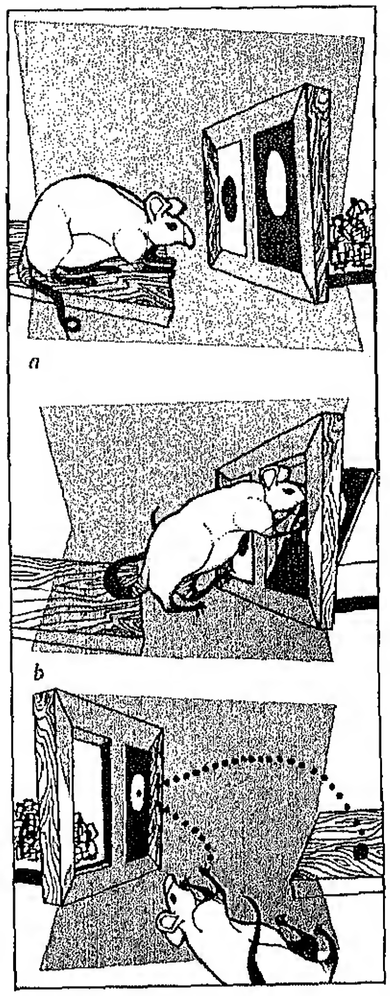


Figure 3.13. A rat faced with an insolvable problem, a, *learns a position habit, always jumping to the right, as a partial solution,* b. *Later, when food is freely available in the left window, it continues to jump to the right,* c, *showing the fixated nonadaptive behavior of frustration.* (From Maier, N. R. F. *Frustration.* New York: McGraw-Hill, 1949.)

HOW FRUSTRATION REORGANIZES BEHAVIOR

So far in this chapter we have described how conditions of blocking or stress lead to the disturbed types of behavior known as frustration. We have seen that frustration is characterized by anxiety and other emotional disturbances. When a solution to the problem is not immediately available,

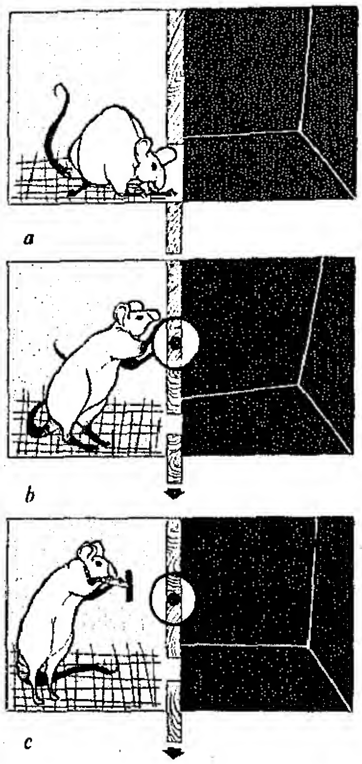


Figure 3.14. After learning to escape a shock in the white compartment by running into the black, a, *rats learned to turn a wheel and then to press a bar to open the escape door,* b, *even though the shock was no longer present.* (From Miller, N. E. Studies of fear as an acquirable drive: I. Fear as motivation and fear-reduction as reinforcement in the learning of new responses. *J. exp. Psychol.*, 1948, 38, 89–101.)

frustration typically involves forms of substitute reactions which can occur in both man and animals. Our problem now is to see how the effects of frustration extend far beyond these immediate patterns of response, affecting the individual's learned behavior in different situations and throughout life.

The Motivating Value of Anxiety. The anxiety which accompanies reactions to blocking or stress motivates the individual to learn modes of response to alleviate the anxiety. The rats in Figure 3.11 learned to fight to get relief from the pain and disturbance of shock. Those in Figure 3.12 learned at different times two different habits: to sit up on their haunches and to press a pedal. The rats in Figure 3.13 demonstrated that a response learned in frustration can persist even when the problem no longer exists, and can seriously interfere with later behavior. It is this carryover effect of anxiety that we are going to consider here, its persistent motivating function in learning.

The experiment described in Figure 3.14 demonstrated that rats continued to learn new habits based on the motivating effect of a learned fear or anxiety. The apparatus consisted of two compartments, a white one and a black one, with an interconnecting door. An electric grill on the floor of the white compartment was used to deliver a light shock. In the first stage of the experiment, the rats were put one at a time into the white compartment and given a shock. They learned to escape the shock by running into the black compartment through the open door (Fig. 3.14*a*). After they had learned this response, they were put back into the white compartment *without the shock* but with the door closed. A rotating wheel mounted above the door would open the door. Even though the rats no longer received a shock, they learned to operate the wheel in order to escape into the black compartment (Fig. 3.14*b*). In the next stage, the wheel was made nonfunctional and a bar mounted on the back wall of the compartment could be used to open the door. The rats were still motivated by the fear or anxiety learned in the first part of the experiment to such an extent that they learned a new habit, pressing the bar, to escape the white compartment. This study demonstrates that a strong fear or anxiety can persist and function as a motivating condition for diverse learning behavior, even in the absence of the original fear-producing stimulus.

In human behavior, the motivating effects of anxiety and aggressive patterns of frustration operating together produce very complicated results in the course of adjustment. Not only does anxiety usually appear as a primary frustration reaction, but, because of social training, an act of aggression or even the thought of it produces further anxiety. Thus, when a situation seems to call for aggression, we have a conflict of motives: to be aggressive in order to relieve our anxiety, and not to be aggressive because of social disapproval. In either case we are faced with the consequences of anxiety. One of the common results of such complicated circumstances is that we end up reducing the anxiety to some extent by one or more of the other frustration reactions, and fail to resolve the conditions causing the original frustration. We are sometimes so busy, so to speak, in keeping our anxiety under control that we have little time or energy to do anything about the original blocking or conflict.

Infantile Frustration and Adult Behavior. The effects of infantile and childhood frustration upon adjustive behavior later in life represents one of the central problems of behavior organization. The view that infantile experiences influence and organize later adjustment was an important aspect of Freudian theory, and is generally accepted by psychologists today. It is not easy to relate adult behavior patterns to specific childhood events, but in some extreme cases the patterns of childhood frustration seem to have direct effects in later behavior. For example, extreme hunger and social stress apparently had long-lasting results in children from the concentration camps or siege areas of World War II.

Since the available studies of frustration in human infants and children are very limited in scope, we shall consider here a series of carefully controlled experiments on the effects of early feeding frustration on adult hoarding activities of white rats.[2] Infant rats, at the time of weaning, were divided randomly into experimental and control groups. For fifteen days the experimental animals were given food at irregular intervals and allowed to eat for only short periods of time, while the control animals were allowed unlimited access to food. After this period of infant frustration, all of the rats were put in the rat colony and allowed unlimited food until they reached maturity.

In order to test the adult rats for hoarding behavior, each rat was placed in a cage attached to an alley at the end of which was a can of food pellets. The number of pellets carried by the rat to its cage constituted its hoarding score.

Hoarding tests were run under two conditions. First, the rats were given the chance to hoard while they were allowed unlimited food. Very few pellets were hauled by the rats during this test, and no significant differences were found between the two groups. Following this test, all food was removed from the rats' cages, and for three days they were allowed food for only thirty minutes a day. Starting on the fourth day of this adult feeding frustration, hoarding tests were run on four successive days. They were allowed to keep the food that they hoarded, and after four days most of them had ceased to hoard. During these critical four days, however, the experimental animals hoarded significantly more than the control animals. Thus the infantile feeding frustration resulted in increased hoarding after the rats had been subjected to adult feeding frustration.

Play Frustration in Children. Because of the undesirability of creating strongly emotional and conflict situations for human subjects, most of our objective information about the nature of frustration is derived from experiments with animals and controlled observational studies of real-life human situations. One of the few experiments with human subjects is concerned with a relatively mild and temporary frustration in young children.

Thirty children from two to five years of age were observed on two different occasions. The first observations were made in the free-play situation shown in Figure 3.15*a*. The children were brought one at a time into an experimental room containing a number of toys, some of which were incomplete or broken—a chair without a table, part of a telephone, a boat and other water toys without water, a teapot without a lid, an iron and ironing board but nothing to iron—and also paper and

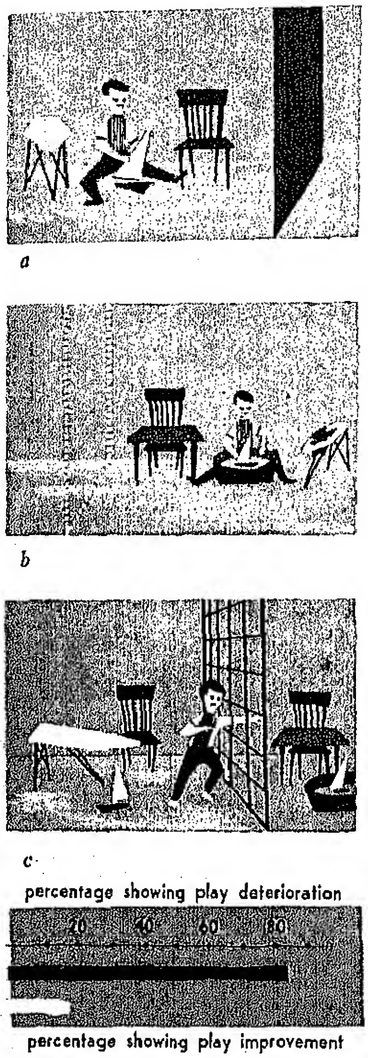


Figure 3.15. Children who played happily with broken or incomplete toys on one occasion, a, *after being allowed to play with more desirable toys,* b, *displayed frustration reactions when barred from the new toys,* c. *Most of them regressed in their play activities,* d. (From Barker, R. G., Dembo, T. and Lewin, K. Frustration and regression: an experiment with young children. *Univ. Ia. Stud. Child Welf.*, 1941, 18, No. 1.)

crayons. The children played happily on this first occasion, using the toys in imaginative ways, some of them drawing or coloring. The constructiveness of their play was rated on a scale designed to relate the type of play activities to mental age. (By mental age we refer to the intelligence level of an average child of a specific age as measured by tests. Thus an average child of age five years has a mental age of five, and any other child who measures the same on tests is said to have a mental age of five.)

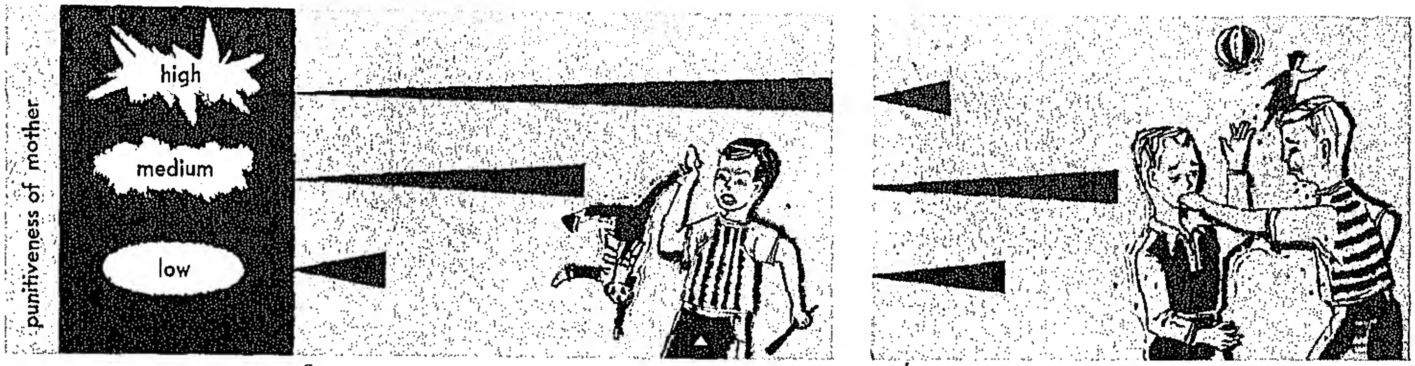
The second time the child was brought into the experimental room, it had been transformed. An opaque screen which had originally cut the room in half had been removed, revealing some new and marvelous toys at the other end. Now the child had real water for his water toys, a doll house with chair, table, and dishes, a telephone with a dial and bell, clothes to iron, etc. (Fig. 3.15*b*). After a period of play with all the toys, the experimenter drew the child back to the original area with the original toys and put a wire screen barrier in place in the middle of the room (Fig. 3.15*c*). Now the new desirable toys could still be seen, but were inaccessible.

The general effects of this blocking situation were twofold. Most of the children showed their frustration in attempts to overcome the barrier or to escape from the room. They used both physical attempts, such as kicking the door, and social attempts, such as coaxing or threatening the experimenter. Their frustration was also apparent in regression in play activities with the accessible toys. They showed an average decrease in constructiveness of play amounting to 17.3 months of mental age. In all, twenty-five of the thirty children were rated as showing decreased constructiveness in play (Fig. 3.15*d*). Very often they threw the toys about or tried to break them, or, instead of drawing pictures, they scribbled. Other reactions included restlessness, stereotyped repetition of sentences, and stuttering.

The amount of time spent trying to overcome the barrier or trying to escape varied considerably from child to child. Using this barrier-escape behavior as a measure of the strength of frustration in the particular child, the experimenters showed that in general the more frustrated children displayed more regression in play.

Parental Discipline and Social Behavior. Early in life the blocking and conflict situations to which the child is exposed lead very naturally to the formation of individual patterns of frustration behavior. As time passes, these reactions become habitual and are organized into general modes of adjustment. Thus an adult responds to many kinds of problems that arise in connection with his job, his family, or other situations with the familiar frustration patterns he has practiced all his life. For example, aggressive behavior in an adult is influenced by the learned patterns of aggression originating in childhood. There are many factors determining an individual's frustration behavior, but one of the earliest is the relationship between the child and the parents.

A number of school children were divided into three groups according to the type of discipline—described as low, moderate, and high punitiveness—used by their mothers. The three groups of children then were studied in school and rated according to the number of aggressive acts committed in doll play and against other children (Fig. 3.16). The number of aggressive acts in



a *b*

Figure 3.16. Aggressive acts of children related to type of discipline of mothers. Children of highly punitive mothers carried out more aggressive acts in play with dolls, a, *but not so many in play with other children as did children of moderately punitive mothers,* b. (From Sears, R. R. Social behavior and personality development. In Parsons, T. and Shils, E. A. *Toward a general theory of action.* Cambridge: Harvard Univ. Press, 1951. Pp. 464–478.)

doll play was very small for children of nonpunitive mothers and high for children of highly punitive mothers (Fig. 3.16*a*). However, the number of aggressive acts carried out against other children was low for children of mothers displaying both low and high degrees of punitiveness, higher for those children subjected to moderate punitiveness (Fig. 3.16*b*).

The most likely interpretation of these results is that the children subjected to the most severe discipline at home were intimidated to the extent that they could not express themselves aggressively in their social interplay with other children. However, the free-play situation with dolls provided an unrestrained outlet for these emotionally disturbed children. In other words, the children subjected to the most severe discipline at home expressed themselves aggressively in nonsocial ways, but not in social situations.

Another study suggests that several other factors operate to determine these social expressions of frustration.[3] The reactions to conflict of a group of junior high school boys were studied in relation to their social group, either middle class or working class, and also in relation to the type of discipline they received from their mothers. Discipline was classified as primarily psychological, consisting of expressions of disappointment or appeals to guilt, or corporal, consisting of spanking, slapping, or threatening. In the middle-class group, sons of mothers who used psychological discipline showed more feelings of guilt about aggressive acts than sons of mothers who used corporal discipline. However, in the working-class group there was no such relationship. Another observation was that sons of mothers who used psychological discipline were indirect in their expressions of aggression, while those subjected to corporal discipline were more direct. In this case the social class bore no relation to the results.

Results such as these point up the difficulties in studying complex behavior patterns. We are reminded once again of the principles of multiple causation and interaction of factors in psychological events.

The Frustration-aggression Hypothesis. Many of the social ills that plague society have to do with expressions of aggression by one person against another or one group against another, as in wars, or in racial and class prejudice. It has been theorized that hostility of this sort has an irrational ele-

ment which develops according to the mechanism of displacement.[4] We have seen how displaced aggression develops in rats (Fig. 3.11). We have also seen that children who are frustrated at home by severe discipline relieve their anxieties by acting aggressively in doll play. In this case the children are inhibited by fear and social training from expressing themselves directly.

Frustration-aggression is often generated in members of social groups by economic insecurities, social conflicts, and other conditions of blocking. In many cases the aggression cannot be given direct expression. Sometimes the causes of the problem situation are unavailable, or unrecognized, or intangible. Furthermore, members of a social group are usually prevented by custom and law from acting aggressively within their group. As an outlet, they generalize or displace their aggression to members of outgroups such as racial or economic minorities.

A study demonstrating displaced aggression was conducted with a group of young men working at a camp who were about to undergo, unknown to themselves, a frustrating experience.[5] They were going to have to take some long, dull, difficult tests which would give them feelings of failure. Furthermore, the tests were so long that the men were sure to miss the high point of their week, attending bank night at the local theater. Knowing all this ahead of time, the experimenters asked the men to indicate their attitudes toward Mexicans or Japanese (this was before Pearl Harbor) before taking their long tests. Afterwards, the men who had previously rated Japanese were asked to rate Mexicans, and vice versa. At the end of their frustrating day, the young men attributed fewer desirable traits and more undesirable traits to foreigners than they had beforehand. The aggression generated against the experimenters, who had had to administer the tests, was displaced to some extent toward foreigners in general.

In a study carried out in the 1930's it was shown that the number of lynchings in the South correlated significantly with the price of cotton.[6] When times were bad and the price of cotton was down, the number of lynchings went up. When the price of cotton went up, lynchings declined. In other words, the economic frustrations brought on by hard times contributed toward displaced aggressive acts against a minority group.

Habitual Reactions to Stress. This sampling of psychological studies of frustration gives us some insight into the development of habitual patterns of reaction to stress and into the importance of these habits in the overall organization of behavior. Most of the people we know react to everyday problems and emotionally disturbing situations in characteristic ways. Some are habitually aggressive, venting their wrath against anyone who is available. The school bully and the tough boss have a lot in common. Since aggression usually leads to additional trouble and social disapproval, it is likely to be self-generating, producing increased anxiety and further aggression. This vicious cycle of anxiety-aggression-anxiety is seen in the juvenile delinquent, whose crimes against society may come about as a result of serious childhood frustration. Changing an established habit pattern which is based on emotional reactions is an extremely difficult undertaking and may meet with little success.

We know other people who react to

stress by withdrawing in timidity, by regressing to childish habits, by daydreaming or indulging in fantasy. These habits are less bothersome to society than aggression, but are no more successful in solving problems. Fantasy is partially successful as a mode of adjustment insofar as it can relieve anxiety. The Walter Mittys of the world get enough satisfaction from their imaginary exploits to reduce their emotional disturbances temporarily, but the original problems remain unsolved.

Persisting frustration sometimes results in behavior breakdown or disorder. In the final chapter of the book we shall describe the serious patterns of disorder, commonly known as mental illness, as well as milder problems such as speech difficulties, delinquency, and the use of drugs and alcohol.

By and large, society counts as successful those individuals who learn to attack their problems head-on, and either solve them or change their own life organization to the extent that the problems no longer block behavior. Most of us have problems and conflicts from time to time that we cannot solve completely, but learn to live with. In so doing we are forced to change the routine of our lives, try out new modes of response, make new friends, get new jobs, and evolve habits of patience, tolerance, and love. Thus we carry out our personal experiments in successful adjustment. The great achievements of mankind do not flower in the humdrum of routine living, but are molded by the stresses and difficulties of a challenging world.

Frustration and Society. It is interesting to speculate whether the number or severity of man's frustrations bears any relation to the type of culture in which he lives. We often hear it said that our modern, industrial, urbanized society is distinguished by the anxieties which is generates. Life proceeds at too fast a pace. We try to do too much, in too little time, in the face of too many conflicts. On the other hand, man has never been free of conflicts and frustrations, although the nature of his problems differs from time to time. The diversity of frustration patterns that can be demonstrated in animals shows how widespread these reactions are in behavior.

Yet we suspect that just as expressions of frustration vary from person to person, they also vary to some extent with social and cultural changes. We have said elsewhere that man to a large extent creates his own environment. He surrounds himself with physical structures as well as complicated psychological structures—moral codes, legal codes, social codes, personal goals and ambitions. Behavior must conform to many standards. The more complex the standards and the more they overlap, the more conflicts are likely to arise within the individual.

In some social groups the standards of conduct are relatively fixed and unchanging from one generation to the next. Although an individual in such a situation has conflicts, he at least knows what is expected of him, what he must do to get along. Individual conflicts are more difficult to resolve when moral and ethical standards are poorly defined. In our own society some individuals move easily from one social or economic level to another, and in so doing often lose contact with the fixed standards of conduct of their childhood. Thus the person who cannot identify himself with a fixed code is likely to experience many conflicts, which may lead to serious frustration behavior.

Although most of us can cope with our

everyday problems of conflict and stress, it is important that we understand how frustration develops and how to reduce or prevent it. This brings us to the problem of control of behavior. We are going to consider some of the procedures which can be used to redirect or modify responses of the individual.

CONTROL OF BEHAVIOR

The control of behavior is nothing new. Every parent who has ever disciplined a child, every teacher who has ever taught new knowledge or skill, every leader who has ever swayed others to his wishes has been practicing behavior control. Some of the techniques we use are as old as man himself, while others have been developed within the new science of psychology. To use them effectively, we need to understand how behavior is motivated, how it is changed through learning, and especially, how patterns of frustration influence other forms of activity.

Scientific understanding of the organization of behavior is particularly important in dealing with seriously disturbed behavior. The treatment of mental illness made almost no progress prior to the establishment of a science of behavior. Although we are primarily concerned here with control of organized behavior patterns within the normal range, it should be pointed out that it is sometimes difficult to draw the line between the normal and the abnormal—to say where ordinary disturbed behavior crosses over into serious behavior breakdown. We need to understand the mechanisms involved in conflict, stress, and frustration at all levels of control.

In Chapter 2 we said that, to a psychologist, patterns of adjustment are neither good nor bad. Yet in speaking of control, we imply that there are some standards against which the success of responses can be judged. Some responses are considered undesirable either because society disapproves of them or because they make the individual unhappy. Our aim in controlling behavior is usually to help the individual (ourself or another) modify his behavior so that it is satisfying to himself and to society.

Making and Breaking Habits. Anyone who ever has gone on a diet, stopped smoking, or worked on a night shift knows that it is not easy to develop new habits or to break old ones. This subject has interested psychologists for a long time. William James, one of the first outstanding American psychologists, commented on the stability of habit patterns in these words:

> Habit is thus the enormous fly-wheel of society, its most precious conservative agent. It alone is what keeps us all within the bounds of ordinance, and saves the children of fortune from the envious uprisings of the poor. It alone prevents the hardest and most repulsive walks of life from being deserted by those brought up to tread therein. It keeps the fisherman and the deckhand at sea through the winter; it holds the miner in his darkness, and nails the countryman to his log cabin and his lonely farm through all the months of snow. . . .[7]

James proposed these maxims to guide the individual who wants to acquire a new habit or break an old one: (1) to launch the effort with as strong an initiative as possible; (2) to make a clean break with the past instead of trying to "taper off"; (3) to seize the first and every possible opportunity to carry out the good resolution in action; and (4) to practice a little

every day in the new response patterns. These maxims for habit making and breaking are as true today as when James stated them, but in the light of our increased knowledge of behavior organization we realize that they are inadequate. We need to recognize how deeply rooted most of our habits are in our emotional needs and in the stress-frustration sequences that have structured so many of our patterns of adjustment. Take, for example, the habits of smoking or overeating. They do not develop in response to a basic need for tobacco or surplus food, but as habit mechanisms which have become woven into the emotional fabric of our lives.

Some of the most important principles to be adhered to in changing modes of response are illustrated in Figure 3.17. Here we see a coed who finds herself failing miserably in her college work. She realizes that much of her difficulty can be traced to poor study habits. She procrastinates, is easily distracted, and never quite catches up with her work. The first step (Fig. 3.17*a*) is when she recognizes her problem and tries to understand it. With a little study she discovers that her poor study habits are based in part on frustration related to academic failure. She has not been able to face up to the situation and by trying to escape it she has only succeeded in making it worse. Now that she has come to grips with her problem, she can lay her plans for the future.

The second phase, shown in Figure 3.17*b*, may be carried on simultaneously with the first. The girl seeks help, both in understanding her conflict and in planning a course of action. At the counseling center, or in talks with her teachers or adviser, she learns more about her problem and what specific procedures to use in setting

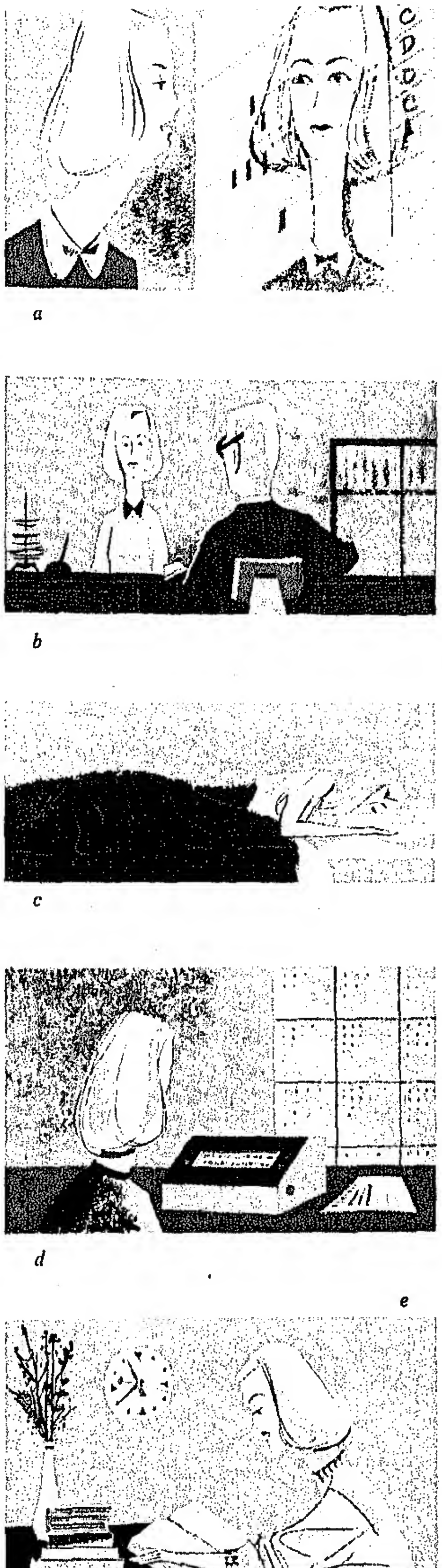


Figure 3.17. Steps in the making and breaking of habits. A coed who is failing in her college work recognizes the nature of her problem, a, *and seeks help in solving it,* b. *While setting up her new routine, she gets plenty of rest,* c, *and follows regular hours. She practices her new habits regularly and adopts new procedures for improving her work,* d. *The new study habits must be integrated into her daily activities,* e.

up new study habits. She may take a course in How to Study.

The need for breaking off old habits and establishing new ones often leads to additional stress and frustration. The girl may be pressured by her family and friends, perhaps by her teachers, to improve her school work. This outside pressure, along with her own anxieties, can interfere seriously with the desired changes. If her frustration becomes severe, the old modes of response may become fixated (as in the rat which jumped toward the locked door instead of toward the food). The girl and her counselors should realize that a behavior readjustment of major proportions can be as debilitating as an illness. She should treat herself much like a convalescent, conserve her resources, follow regular hours, and get plenty of rest and proper food (Fig. 3.17*c*).

The new study habits which have been outlined should be practiced regularly. In Figure 3.17*d* the girl is trying to improve her speed of reading by using a training device. She also practices systematic note taking, outlining her work, using a dictionary and other reference works, and reviewing her assignments repeatedly. Finally, her new habits of study should be integrated into her daily activities (Fig. 3.17*e*). She learns that it is best to have a quiet, orderly place to study, and to allot a portion of study time to each task. We might do well to repeat here one of James' maxims: Never allow an exception to occur.

Habits that fulfill emotional needs cannot be broken easily. We cannot break up old ways of reacting without setting up new modes of response, and often it is difficult to replace an undesirable habit with another that is truly desirable. One person tries to stop overeating and takes up smoking instead. Another tries to stop smoking and finds himself nibbling all day long. A better approach in some situations, although certainly a more difficult one, is to try to eliminate or reduce some of the emotional disturbances or anxieties with which the undesirable habits are associated. If the stresses and conflicts cannot be avoided, it is sometimes possible to reduce their disturbing effect on behavior. Some of the techniques which are widely used to reduce emotional tension and anxiety are training courses in relaxation and recreational activities, and psychological counseling.

Counseling Techniques. Control of behavior often requires more than individual efforts. Most people face problems in everyday living which they cannot solve without help from others. Friends, teachers, parents, ministers, doctors, and many others are requested to give information and advice. All of these people are engaged in some form of counseling—that is, aiding people in finding solutions to their problems. Many professional psychologists counsel people with various types of personal difficulties. The counseling psychologist is trained in interviewing, in test interpretation, and in an understanding of many types of adjustive behavior.

Some of the steps ordinarily followed in vocational or educational counseling are shown in Figure 3.18. In the first interview the counselee describes his problem (Fig. 3.18*a*). He may have difficulty in choosing a vocation because of conflicting motives or lack of confidence in his abilities. Or, he may have a physical handicap which limits his behavior. These and many other problems in adjustment are similar in that they require the selection of a new mode of behavior in order to overcome con-

flict or blocking in motivated activity.

The selection of a new response pattern is the task on which the counselor and counselee work together. In subsequent sessions they discuss possible lines of activity in terms of the counselee's past experience and present interests. Possible vocational choices, for example, must be evaluated in terms of the counselee's needs for economic security and prestige, his general interest patterns, and his abilities. Often the counselee needs to know more about his own assets and liabilities before he can make a reasonable choice. Psychological tests of interests, abilities, and personality characteristics (Fig. 3.18*b*) can aid him in understanding himself. At this stage, the counselor often acts as no more than a good listener as the counselee thinks out his problem (Fig. 3.18*c*). By this time he is able to reject some lines of behavior as unsuitable for him and to select others as possible solutions to his problem. After obtaining more information about his possible choices, the individual, with the help of the counselor, compares each line of activity with his own assets and liabilities in order to choose the one best suited to him. Formal counseling usually stops when the new mode of behavior is chosen, but the end result of counseling is the actual adoption of the new activity (Fig. 3.18*d*). If the individual actually succeeds and is happy in his chosen course, the counseling has been a success.

The success of vocational counseling has been studied by questionnaire methods. In one study the employees of a company which had a vocational counseling program were questioned concerning their general attitudes toward the counseling and its effects.[8] More than 82 percent of those who answered the questionnaire considered

Figure 3.18. Steps in vocational counseling. The counselee outlines his problem to the counselor, a, *and takes tests to determine his strengths and weaknesses,* b. *Together they map a course of action,* c, *until the new activity is adopted,* d.

counseling worthwhile. A group of veterans who had undergone vocational counseling for postwar job placement were also questioned. The results showed that 82.4 percent of the veterans were satisfactorily placed in jobs, according to their own and their employers' estimates. Only 3 percent of the veterans changed jobs during the first nineteen months after counseling. This labor-turnover figure is far below the national average during this period, and also below the average in any industrial city.

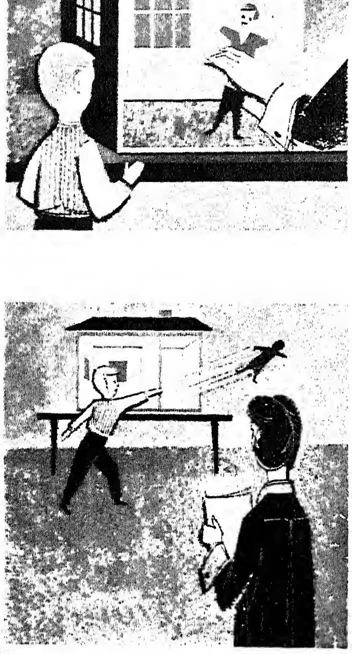


Figure 3.19. The use of play therapy in understanding children's behavior problems. A child allowed to play house with dolls discloses his hostile feelings toward a member of his family by throwing a doll out of the house. By observing unrestricted play activities, the counselor gains insight into the child's problems, while the child gains new confidence in himself and is helped in working out new modes of response.

Play Therapy. The control of adjustive behavior problems in children usually cannot be handled by verbal counseling, because children often cannot express, much less solve, their difficulties in words. A useful technique is to allow the child free expression of his needs and anxieties in unrestricted play.[9] The counselor provides dolls, modeling clay, drawing materials, and the like, and the child is encouraged to play freely. Any unusual, inadequate, or socially disapproved responses help the counselor understand the source of the child's problems. For example, if he plays house with dolls and punishes the mother doll, he may be expressing resentment toward his own mother. This type of play with dolls is illustrated in Figure 3.19.

In addition to providing the counselor with some insight into the child's problem, the unrestricted play helps the child by giving him an opportunity to act out aggressive and hostile feelings which cannot be expressed in real life. As the child gains confidence in himself and the counselor, new modes of behavior can be worked out to replace old ones. Learning to control behavior in his play world helps the child to adopt new modes of response in his social world.

Role Playing. Role-playing techniques differ from counseling in that the behaviors involved in adjustment problems are not dealt with on a verbal level, but are acted out within a controlled situation. Role playing, or psychodrama, was first developed for use in studies of social behavior, in marriage counseling, and in the treatment of disturbed patients.[10] More recently, role-playing techniques have proved valuable as an aid to training in schools and industries.

Role playing serves a variety of purposes in the control of behavior. It can be used for indicating adjustment difficulties, for releasing feelings which cannot be expressed in words, for gaining experiences with another individual's problems, and for trying out possible new modes of behavior. It can be used very effectively in group counseling—that is, in dealing with a group of people with a common problem, such as groups of students or mothers—to broaden understanding of the problem, to change attitudes, and to develop new behaviors. Students taking courses in education, social work, industrial relations, or other fields of human relations can use this method to get the "feel" of social roles. Role playing is also being used in industry to help train supervisors in public relations.[11]

Some of the uses of role playing are illustrated in Figure 3.20. An imaginary situation is outlined, in which different individuals take roles, as in a skit, and work out the action and dialogue spontaneously (Fig. 3.20*a*). The general purpose is to give the participants experience with the attitudes and behaviors of a problem situation. A group of education students might take the roles of a naughty child, an angry teacher, and a stern principal. Or, a group

a b c

Figure 3.20. *The use of role playing in training situations.* a. *A group of students or trainees gain experience in a situation by acting out a skit spontaneously.* b. *At times the audience is also allowed to participate in the action.* c. *Closed-circuit TV permits large groups to view role-playing activities without inhibiting the free expression of the players.*

of supervisors might take the parts of workers and foremen in acting out a shop problem. By acting out the attitudes of others, individuals gain an understanding of the different points of view and of how these differences can be resolved. Skit role playing can be used in counseling and training to try out a proposed solution to a problem. A supervisory group, for example, proposes that the supervisor should try to discover through friendly discussion the reasons for a worker's habitual tardiness. The two actors play out their roles according to their interpretation of the problem, and the group discovers possible consequences of this solution.

In audience role playing (Fig. 3.20*b*) some of the members of the group observing the skit take parts and participate in the action. In supervisory training the group might assume the roles of union members and participate in the situation created by the skit. A "mock" political convention demonstrates the use of audience role playing in furthering understanding of the behavior of large groups.

As shown in Figure 3.20*c*, closed-circuit TV can be used to extend the scope of role-playing activities. A small group engaged in role playing can be televised and observed by other individuals or groups whose immediate presence with the players might inhibit their freedom of expression.

Since these methods are relatively new, quantitative study of behavior changes resulting from role playing is not extensive. Experience with these techniques in industry [12] and in the classroom indicates that role playing can produce changed attitudes and give deeper insights into the problems of others. For example, the role playing of a collective-bargaining session by a group of industrial management and labor people before a class of students leaves a lasting impression of the problems faced in such a social situation. However, not all individuals can participate freely in such activities or profit by them.

Our descriptions of making and breaking habits, counseling, play therapy, and role playing indicate some aspects of a broad interest which exists today in the scientific study of control of adjustment. To understand more of the causative fac-

tors underlying such control, we shall need to examine the variations in human behavior patterns in more detail. In later chapters we shall consider some of the phenomena of learning, perception, emotion and motivation, problem solving, communication, group discussion and participation, and psychotherapy. Our discussion in these early chapters of some of the general problems of adjustment will become more meaningful as we relate them to the basic mechanisms of behavior.

SUMMARY

When motivated behavior is blocked by an obstacle, new forms of response must be tried. When the blocking induces emotional tension and disturbed, disorganized behavior, we say that the individual is frustrated.

A conflict of motives often results in frustration. The three types of conflict are approach-avoidance, approach-approach, and avoidance-avoidance.

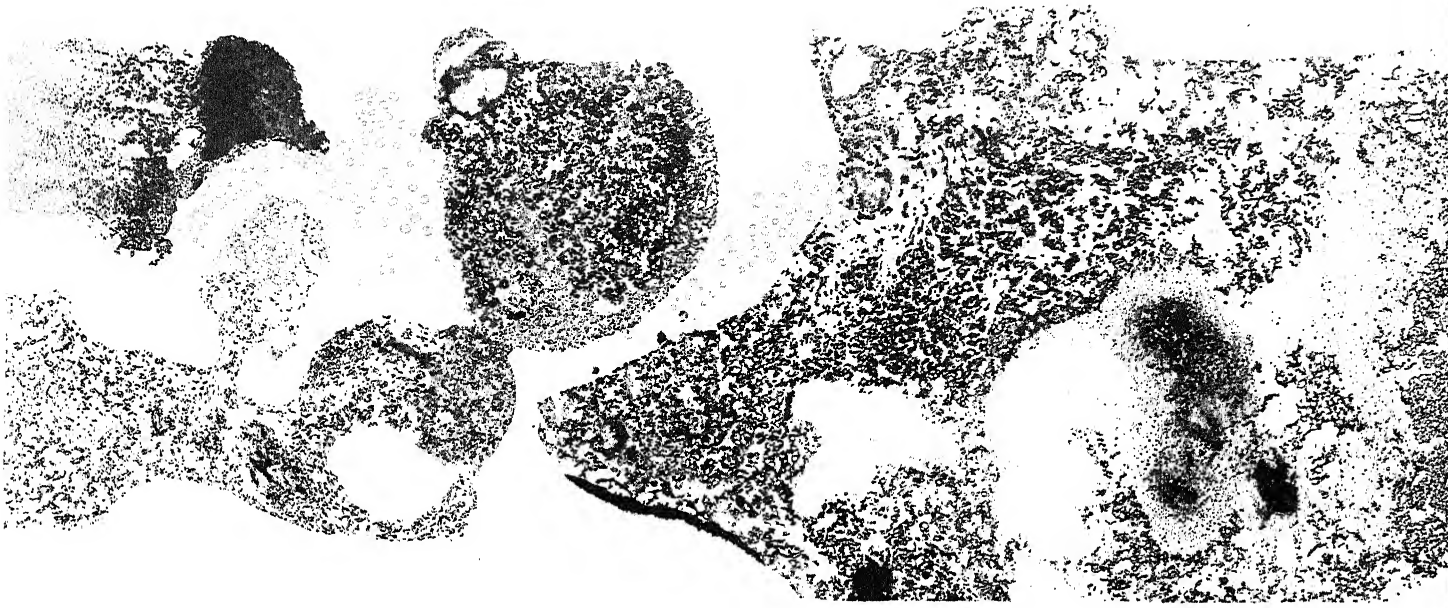
Typical frustration reactions in children are selfishness, temper tantrums, oversensitivity, overdependency, hostility, and self-imposed isolation. In addition to emotional disturbance, frustration often involves responses which substitute for the blocked or goal-directed behavior. Typical frustration reactions include fixated behavior, fantasy and dreaming, compensation, identification, regression, sublimation, displaced aggression, repression, rationalization, projection, and reaction formation.

Frustration patterns involving anxiety, displaced aggression, regression, and fixated behavior have been produced experimentally in animals.

The anxiety of frustration is a powerful motive which leads to new forms of response. Reactions to stress early in life mold characteristic habit patterns which persist in later life.

The frustration-aggression hypothesis states that individual or group hostility against members of outgroups can develop as the displaced aggression of frustration. Aggression is likely to be self-generating through the cycle of anxiety-aggression-further anxiety.

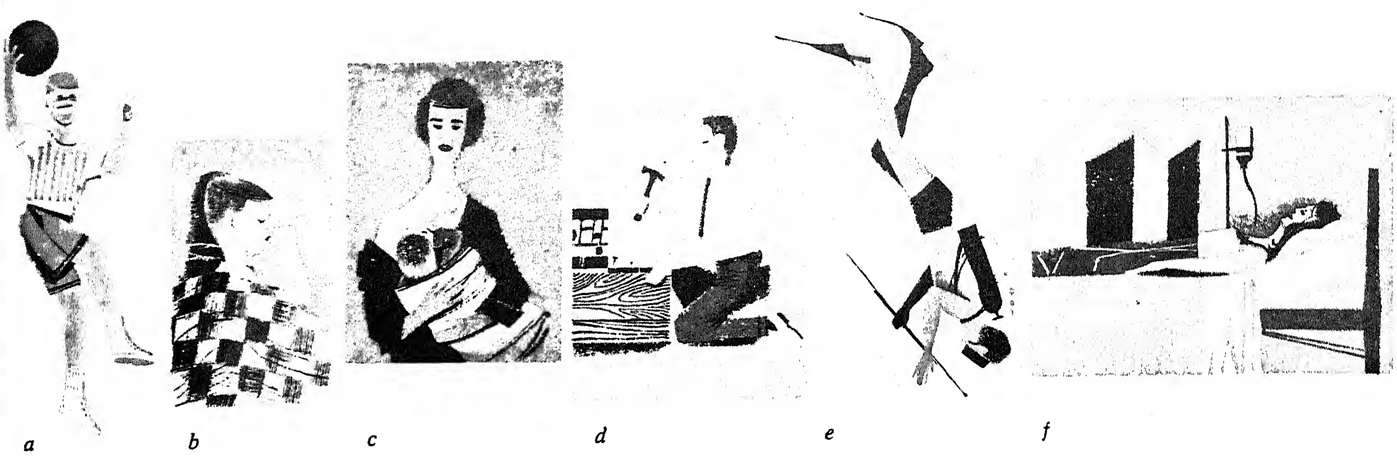
Serious frustration poses problems in the control of behavior. Individuals with behavior disturbances can be helped in the reorganization of their modes of adjustment by the techniques of habit making and breaking, counseling, play therapy, and role playing.



CHAPTER 4. MAN AS A BEHAVING ORGANISM

The outward, observable behavior of the individual is but one manifestation of the living organism. The internal workings of the individual in respiration, digestion, circulation, glandular secretion, and other organic activities are inseparably related to the outward movements of the body. One kind of activity cannot go on without the other. One cannot be changed without modifying the other. External behavior and internal processes are, in fact, different aspects of the same thing—the overall adjustment of the individual to his environment.

The experimental psychologist studies the relationships between observable behavior and bodily processes to gain greater insight into the organization of response. If we were to confine our observations to overt behavior, we would have but a limited knowledge of the psychological activities that go on within the body. The subtlety of some of our implicit behaviors — our thoughts, ideas, emotions, and perceptions —puts them almost beyond the range of ordinary observation. We study implicit responses in terms of what the individual tells us is going on within his body—what he perceives, or thinks, or feels. But to gain a fundamental understanding of these processes, we need to "get inside the body" with our most imaginatively designed apparatus and our most sensitive recording devices. Through the results of such study, combined with our observations of overt behavior, we gain insight into the way in which



a b c d e f

Figure 4.1. All kinds of behavior involve correlated physiological processes. a. *Active states are a form of motivated behavior which utilize the body's stored energy, while,* b, *sleep is another form of motivated behavior which helps the body recover from its activity.* c. *Nursing a baby is both an overt activity and a physiological process.* d., e. *Individual adjustment to the external and social environments involve physiological adjustments as well.* f. *During illness, behavior and physiological functions influence each other.*

all bodily activities are organized in adjustment.

The forms of behavior shown in Figure 4.1 illustrate some of the relationships between overt response and bodily processes. The boy playing is maintaining a high level of activity which serves as an outlet for emotional needs and at the same time leads to expenditure of stored energy within the body. The sleep of the youngster with his thumb in his mouth is not only a form of motivated behavior but is also a means of recovery of the child's body from a day's activity. The activity of the nursing mother is part of a general social and emotional response to the child and, in addition, involves physiological changes in the female body. The failure of the child to nurse properly, or an emotional disturbance in the mother, can alter the milk flow and change the reactions of the mother toward her baby.

The process of adjustment has complementary psychological and physiological aspects. The engineer shown packing his books has completed his college education. In this process of development, learning, and thinking, he has changed both his behavior and the make-up of his body. If his ability as an engineer is challenged, he becomes very emotional about it. His whole life organization—marriage, sex behavior, eating, and sleeping—is tied to his engineering activity.

The diver illustrates another form of adjustive change in behavior. As he descends hundreds of feet below the surface of the water, his body adjusts to the increased pressure of the ocean depths. In surfacing, these adaptive changes are reversed; but should he try to do it too quickly, he might kill himself in the process. Similarly, people become acclimated to living at high altitudes or extreme temperatures, and their behavior is changed as a consequence of these physiological adaptations. The sick girl illustrates the relations between behavior and bodily functions during stress. Illness alters the nature of behavior, but, on the other hand, behavioral reactions help determine the course of an illness. Illness often leads to increased worry and anxiety, but worry and anxiety also enhance the seriousness of physical disorders.

HOW THE ORGANISM ADJUSTS ITS ACTIVITY

The behavior of the individual is marked by many variations in the level of activity. There are regular daily shifts in patterns of sleep and waking. There are the more irreg-

ular variations between excitement and depression, enthusiasm and boredom, or sickness and health. The life of an individual is also marked by long-time variations in activity level, from infancy through the active years of childhood to the gradually decreasing level of activity in maturity and old age.

Variation in level of activity is a matter of timed changes in the physiological processes of the living organism, or of the effects of external stimulation on the body, or of both these factors acting together. The sleep pattern of the human individual, as we saw in Chapter 1, is influenced both by physiological processes and by the external environment.

Activity and Migration. Some of the most striking examples of timed changes in activity level are found in the migratory activities of animals. The great seasonal migrations of birds are marvelously well-organized patterns of behavior, controlled in ways that are still something of a mystery. Some birds travel thousands of miles over water in the course of migration. They prepare for their flight by resting and feeding, but once the migration is under way, they maintain themselves at a high peak of activity with little rest or food until the destination is reached. Migration activities are subject to physiological controls, yet under certain environmental conditions, the pattern does not unfold. Mallard ducks in the wild state make regular migrations, but, if they become accustomed to regular feedings in a farmer's barnyard, they become as domestic as chickens.

Migratory behavior patterns are characterized not only by variations in overall activity level but by responses that are specifically organized within the environment. Migrating birds return to the same neighborhood year after year. Mature salmon return to the stream where they hatched to spawn. Migration is directed both by internal regulation of activity and by external conditions of stimulation.

Figure 4.2 shows how timed changes in amount and direction of activity occur in the life of the great sea turtle. Once or twice each year, during the summer months, the female loggerhead turtle comes in from the open ocean and climbs a sandy beach to carry out her nesting activities. She digs a large hole in the sand with her hind flippers and deposits in it one hundred or so eggs. After covering the eggs and camouflaging the area, she returns to the sea. These activities of the female turtle are timed to occur at a certain season of the year. After about fifty days, the young turtles break out of the eggs by their own activity, mill around in the nest, and eventually escape as the sand ceiling sifts down among the empty egg shells, thus raising the floor of the nest. Once out of the nest, at night or by day, the little turtles move rapidly and without deviation to the surf and start swimming toward the open ocean. Their orientation toward the ocean depends on the brilliance of the surf, which serves both to drive and to direct their movements.[1]

The great sea turtles spend most of their lives in the open ocean. These episodes on land—the nesting activities of the female and the escape activities of the newly hatched turtles—require a general activity level higher than usual. They also require specific environmental orientations. These complex behavior patterns are regulated both by internal bodily mechanisms and by appropriate environmental conditions.

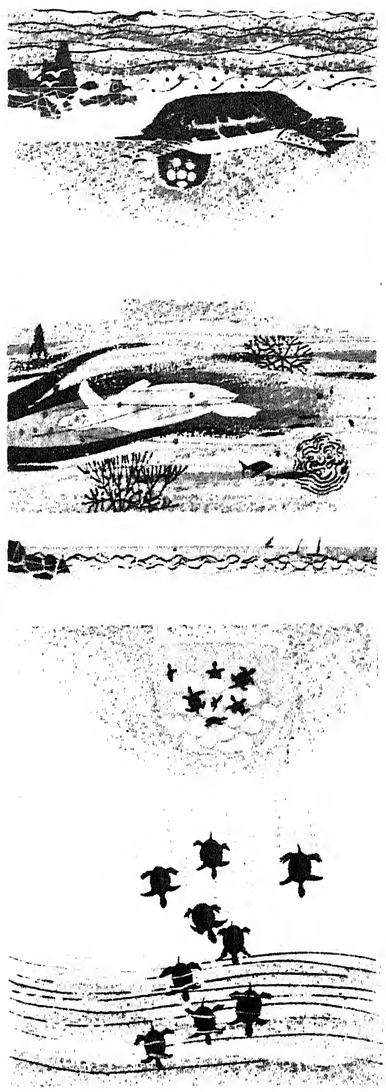


Figure 4.2. Migratory activities are timed and directed by internal states and external stimuli. The female loggerhead turtle comes to a beach during the summer to lay its eggs. When the little turtles hatch, they are guided to the ocean by the reflection of light from the surf.

Figure 4.3. The occurrence of emotional disturbances is due to external stimuli and the internal state of the individual. Anger is a general response which persists in time and interrupts other forms of behavior.

Activity and Emotion. Behavior in the human organism shows much more variability and flexibility than in lower animals. We see nothing in people to compare with animal migration, for example. However, all of the human activities related to motivation and emotion have much in common with the more strikingly patterned animal behaviors which we have described. When we study human motivation and emotion in more detail, we shall see that they involve characteristic changes in the level and direction of activity regulated by bodily mechanisms interacting with external stimulation. To give an example of what we mean, we are going to describe the occurrence of a pattern of emotional behavior in an ordinary human situation.

The conference table is often a good place to observe the occurrence and timing of emotional activity. If a strong difference of opinion exists, the individuals respond not only in terms of training and intelligence but also with primitive emergency reactions evolved ages ago in the body of man.

In Figure 4.3*a* we see a man who has been in a conference all afternoon. Quite suddenly he jumps to his feet and starts pounding the table in anger. This emotional disturbance occurs at this particular time for several reasons. One of the other men has just made a statement that the angered man cannot accept, but the same sort of statements have been made all afternoon. Part of the trouble is that the conference has been deadlocked for several hours, and emotional tension has been increasing steadily. Another factor is the time of day. Almost everyone is more irritable late in the afternoon, especially after a long, hard day. The angry aggression is due, then, not only to the irritating statement which triggered it, but also to the current level of emotional activity within the individual.

Once the outburst has occurred, it does not dissipate quickly. The excited man carries his resentment home with him and is disturbed at dinner and throughout the rest of the evening (Fig. 4.3*b*). He may take a drink to try to relax. He finally goes to bed, but does not sleep well. In the middle of the night he is still tossing fitfully and dreaming (Fig. 4.3*c*). The effects of the conference may last for a day, or even longer.

This example illustrates a principle of behavior which cannot be overemphasized. The moment-to-moment responses of an individual, his learned habits, his perceptions of the world about him, and all of the specific details which mark his ongoing behavior are superimposed, as it were, on more general patterns of motivation and emotion. Later on we shall study these different aspects of behavior and try to understand their nature. However, we shall be continually reminded that no one aspect of behavior goes on independently of the others. Patterns of motivation and emotion are influenced by learned habits and present events no less than learning and perception are influenced by the emotional-motivational state of the organism.

Activity Induced by Chemical Stimulation of the Brain. The behavior patterns described above are at first glance very different, but they are alike in that they involve changes in general activity level which last for relatively long periods of time. The changes in migration go on during days, or even weeks. The variations which characterize emotion last for hours. In fact, in some people emotional patterns persist almost indefinitely. What are

the bodily mechanisms underlying these changes in activity level? Before trying to answer this question, we are going to describe an experiment showing a clear-cut relationship between bodily processes and activity.

The photographs in Figure 4.4 show a method of injecting hormones directly into a rat's brain in order to study the effects of the chemical stimulation of the brain on motivated activity.[2] In the first picture (Fig. 4.4*a*), the experimenter is shown implanting a very fine hypodermic needle into the brain of an anesthetized rat. When the animal has fully recovered from the operation, a fine plastic tube from a syringe is attached to the hypodermic needle (Fig. 4.4*b*). The subject in this experiment, a male rat, is then placed in a pen with scraps of paper and five newly born rat pups. In Figure 4.4*c* one of these pups can be seen directly in front of the adult rat's nose. When the experimenter injects a very small amount of female sex hormone directly into its brain, the male rat acts like a female rat with young (Fig. 4.4*d*). It collects all the paper in the pen to make a nest and then retrieves the pups and places them in the nest.

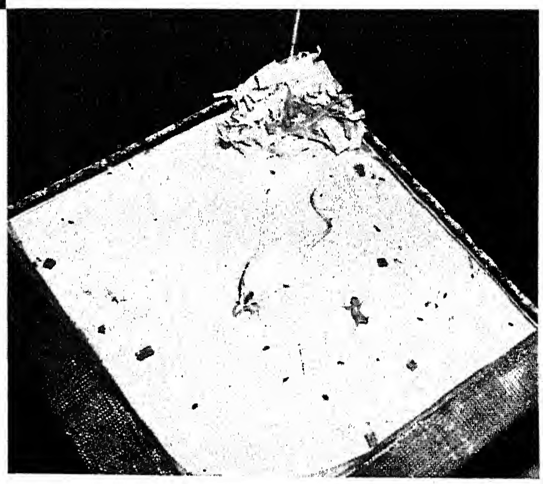
This experiment provides a clear demonstration of organized activity instigated by direct chemical stimulation of the brain. If the female sex hormone is injected into the muscles or circulatory system of the male rat, it does not show these nesting activities. In order to be effective, the hormone must be present in a sufficient amount in the brain itself.

Neural and Glandular Interaction. As a result of many kinds of observations like those just described, we have some broad ideas about the way motivational and emo-

a

b

c



d

Figure 4.4. Direct chemical stimulation of the brain produces organized behavior. A hypodermic needle is implanted in the brain of a male rat, a, *and a plastic tube attached,* b. *When one of the female sex hormones is injected into the rat's brain,* c, *the male rat carries out maternal nesting activities and cares for newly born rats,* d. (Courtesy Alan E. Fisher.)

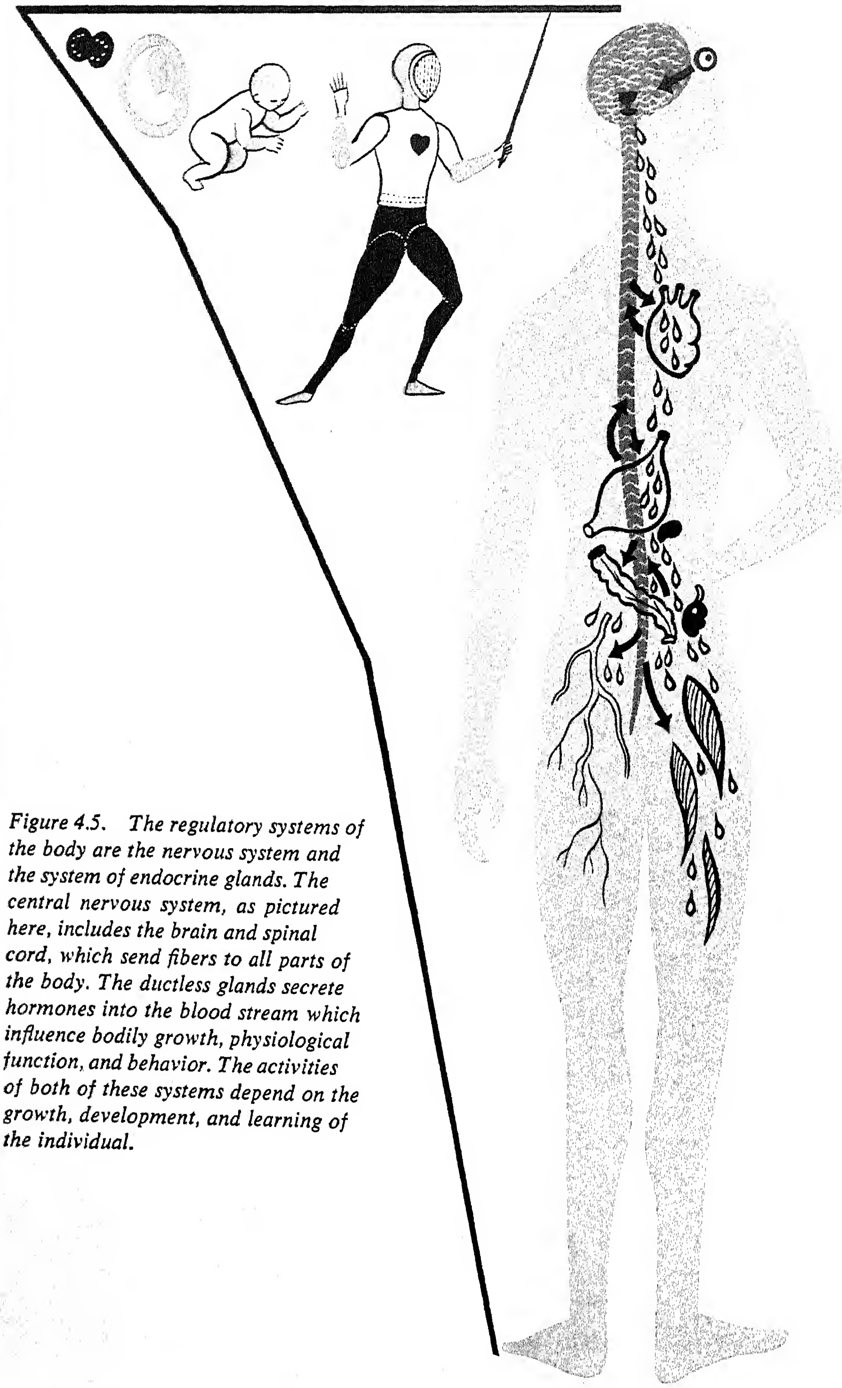


Figure 4.5. The regulatory systems of the body are the nervous system and the system of endocrine glands. The central nervous system, as pictured here, includes the brain and spinal cord, which send fibers to all parts of the body. The ductless glands secrete hormones into the blood stream which influence bodily growth, physiological function, and behavior. The activities of both of these systems depend on the growth, development, and learning of the individual.

tional activities are regulated. There are two general types of bodily mechanism which influence and control the direction and level of activity. The first of these mechanisms is the *nervous system;* the second is the *system of endocrine glands,* or ductless glands (Fig. 4.5).

The nervous system is a network by means of which environmental stimuli can activate the bodily organs and the muscles which support and move the body. Neural activity originates in the bodily organs and muscles as well as in the eyes, ears, and other sensory organs of the body. These neural messages instigate behavior by activating the responding organs of the body —that is, the muscles and glands. In Figure 4.5 we indicate diagrammatically the *central nervous system.* A rich network of nerve fibers carries incoming and outgoing neural impulses between the central nervous system and all parts of the body. The incoming impulses are carried over the *sensory,* or *afferent,* pathways of the nervous system, and the outgoing impulses over the *motor,* or *efferent,* pathways.

All of the organs of the body, including the muscles, are also affected by chemical secretions, or *hormones,* produced by the ductless glands. These secretions are poured directly into the blood and carried to all parts of the body. The chemical activation of behavior is indicated in Figure 4.5 by the droplets interconnecting the small black area in the brain with the heart, the stomach, the kidney, the intestine, the ovary, the blood vessel, and the muscles of the body. The different chemical secretions from the ductless glands have many different effects in behavior. We have just described one example—the effect of the injection of female sex hormone on the activity of the male rat.

The nervous system and endocrine system do not act independently; the activities of each affect the other. The combined effects of these two systems result in *neurohumoral regulation* of activity. One of the most important areas in the body for these integrated effects is shown by the small black area in the brain in Figure 4.5, representing the pituitary gland and a region of the brain called the hypothalamus. In this region, chemical substances from glands of the body stimulate nerve cells and thus influence the action of the nervous system and behavior.

The integrative activities of both the neural and glandular systems of the body depend on the past history and development of the individual, as shown by the stages of growth in Figure 4.5. Past experience modifies both the neural and the glandular make-up of the body, making the individual prone to react to certain types and conditions of stimulation as well as determining the general level and pattern of activity which characterizes adjustment.

The Endocrine System and Activity. The endocrine system of the human body is outlined in Figure 4.6. The *pituitary gland,* sometimes called the master gland, secretes many hormones, some of which stimulate or inhibit secretion in other ductless glands, including the sex glands. One of the pituitary hormones regulates the general rate of growth of the body. The *thyroid gland,* well known because of its close relation to general activity level, secretes *thyroxin.* If the supply of this hormone is low, the individual is sluggish, while an oversupply of thyroxin results in overactive behavior. Two pairs of small *parathyroid glands,* located adjacent to the thyroid, regulate the level of calcium and phosphorous in the blood. If they are overactive, the individual becomes sluggish; if underactive, he becomes tense, with headaches and muscular pains.

The *adrenal glands,* located on top of the kidneys, are composed of two separate parts: an inner core, or *adrenal medulla,* and a covering, or *adrenal cortex.* The medulla secretes the hormone *adrenalin,* which, when released into the body during strong emotion, speeds up the heart, increases blood pressure, and mobilizes sugar. The adrenal cortex secretes a complex of hormones known as *cortin.* One of these substances is related to the development of masculine traits, while other components regulate the sustained reactions of the body to prolonged conditions of stress.

The principal sex glands are the *ovaries* in the female and the *testes* in the male The ovary secretes at least two hormones, *progesterone,* which is essential for pregnancy, and the *follicular hormone,* responsible for the development of female secondary sexual characteristics. The male sex hormone, *testosterone,* affects both sexual behavior and development of the male secondary sexual characteristics.

The ductless glands affect each other in regulating activity in the body. These interactions are not fixed, but change constantly according to the external and internal factors acting on the entire neurohumoral system. For example, after exposure to cold, the adrenal cortex and thyroid become more active and the endocrine system strikes a new balance. Under these conditions, the individual's emotional reactions and other activities are different from what they might be at a different hormonal state.[3] Some of the important hormonal interactions, as well as the reciprocal activation of the pituitary gland and the brain,

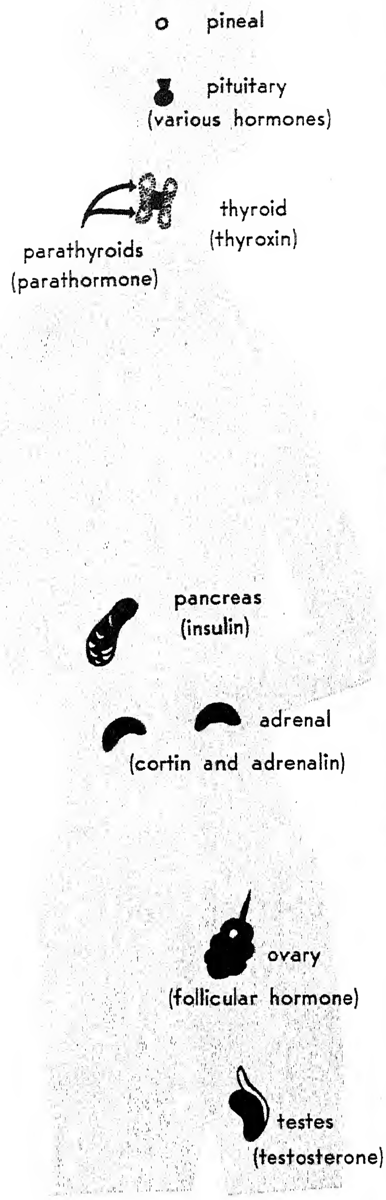


Figure 4.6. The system of endocrine glands. Pictured are the ductless glands of the body and the principal hormones they secrete. The pituitary gland is sometimes called the master gland because it secretes many hormones, some of which exert specific effects on other ductless glands.

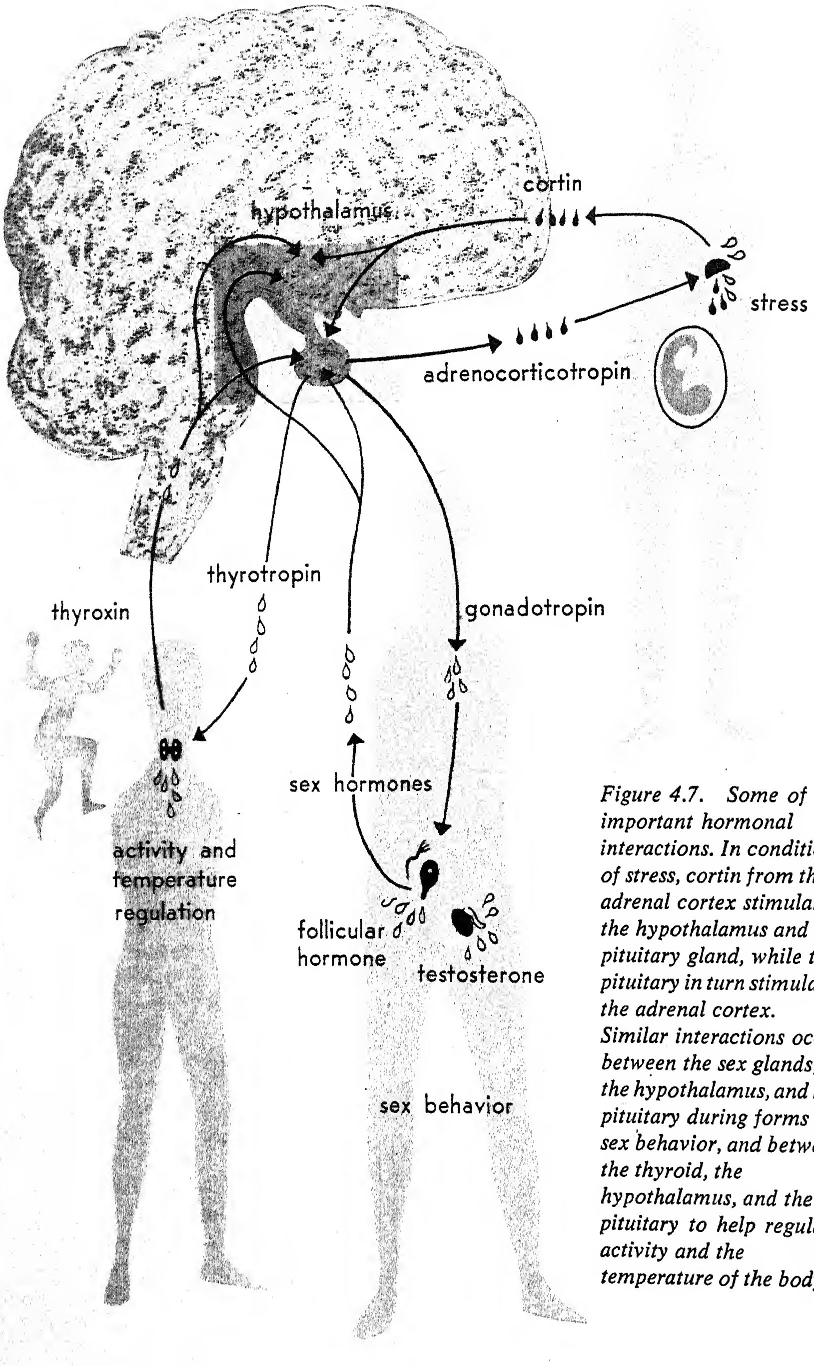


Figure 4.7. Some of the important hormonal interactions. In conditions of stress, cortin from the adrenal cortex stimulates the hypothalamus and the pituitary gland, while the pituitary in turn stimulates the adrenal cortex. Similar interactions occur between the sex glands, the hypothalamus, and the pituitary during forms of sex behavior, and between the thyroid, the hypothalamus, and the pituitary to help regulate activity and the temperature of the body.

are shown in Figure 4.7. Specialized nerve cells located in the hypothalamus secrete chemicals which stimulate the pituitary gland, while pituitary hormones carried in the blood stream in turn affect activity in the hypothalamus.[4]

There are several important features of the chemical regulatory systems which help us understand the motivational-emotional organization of behavior. The chemical substances carried throughout the body in the blood stream sometimes have very *general* effects throughout the organism. Even when the chemicals act through the hypothalamus, the bodily effects are often of a general nature, such as an overall raising or lowering of activity level. Further, chemical substances in the body usually have relatively *gradual* and *long-lasting* effects on behavior. The migratory patterns of animals and other motivational behaviors are maintained in part by hormonal balances which develop gradually and change slowly.

Neurohumoral Regulation of Activity. Responses of the muscles and internal organs are started by neural impulses and, to some extent, by direct hormonal action. It is known that some hormones, adrenalin for example, can affect muscular activity directly and thus influence the level of behavior. But for the most part, the complicated activities comprising behavior are controlled through the central nervous system, through the mediation of the brain.

The brain mechanisms which regulate the level of activity from sleep to highly active states are diagrammed in Figure 4.8. At one end of the activity scale is the reduced level observed in sleep or comatose states. Closely related to these are the depressed states characteristic of some illnesses, in-

cluding some of the behavior disorders. At the other end of the activity scale are the highly alert and active states seen in some kinds of motivated behavior and emotion. During the active states, the brain itself maintains a high level of activity which can be recorded as "brain waves," or patterns of electrical activity of the brain. We call this typical brain-wave pattern of the active states the *activation pattern* of the brain. It depends on the inflowing of neural impulses over the great afferent nerve pathways from all parts of the body —from the eyes, ears, skin, muscles, and internal organs. In addition, the activation pattern of the higher levels is maintained by impulses from certain lower centers of the brain, which are sensitive not only to neural activity but also to concentrations of hormones in the blood stream. This dual influence on the brain, both neural and chemical, is diagrammed in the small insert in Figure 4.8. When the overall activation level of the brain is reduced by a reduced sensory input and/or changes in the hormonal balance, bodily activity goes on at a reduced level, as in sleep.

The larger diagram in Figure 4.8 indicates the control of activity states through the mediation of the brain by way of the motor nerve pathways. The motor pathways arise, as shown in the diagram, in many different parts of the brain and send out nerve fibers to all parts of the body. The differences in activity in the brain which we have just described are reflected in differences in overt behavior.

The interrelationships shown in Figure 4.8 have no beginning and no end, but are aspects of the continuing series of adjustments and readjustments which we know as behavior. Sensory impulses make their mark on behavior in terms of the

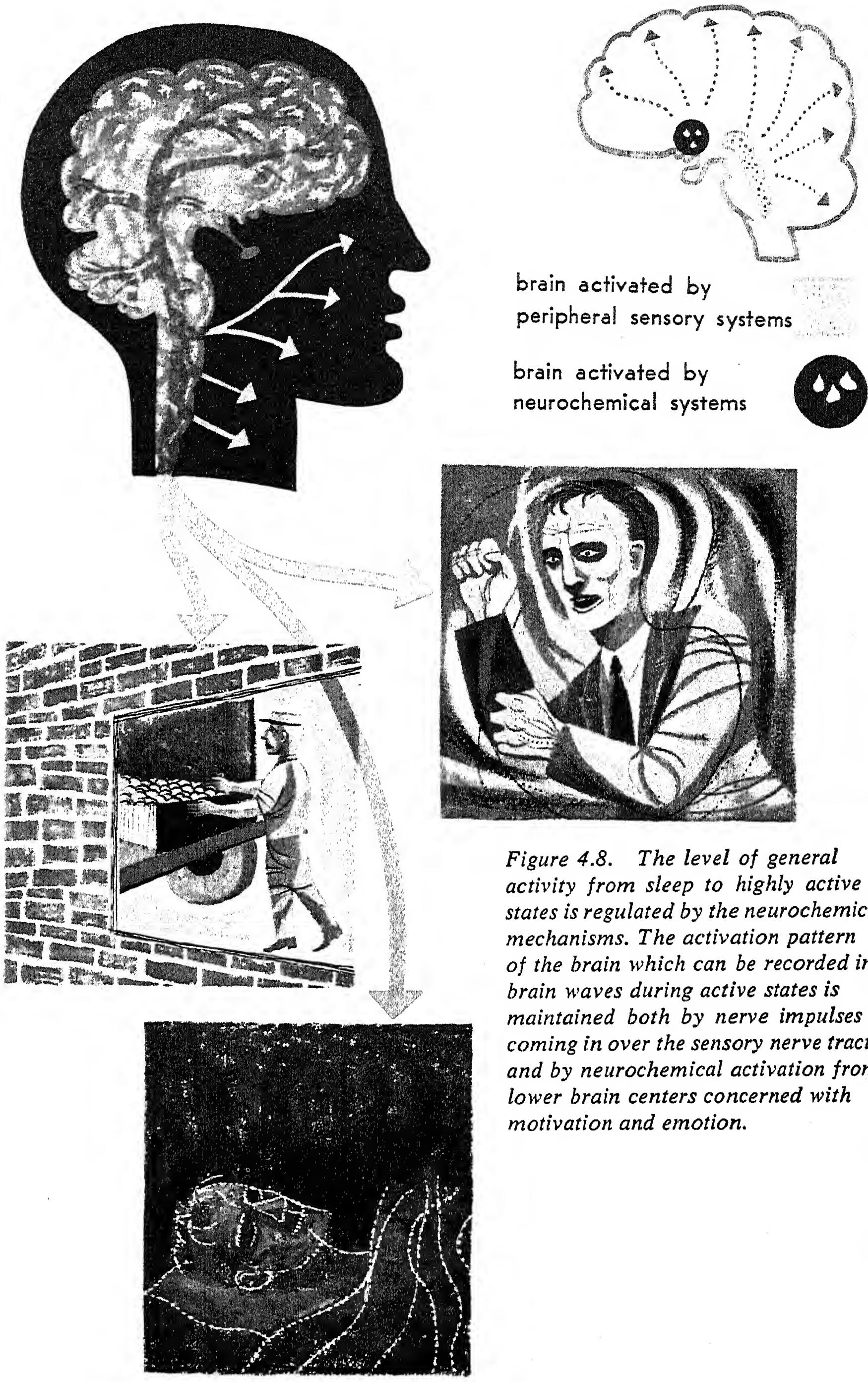


Figure 4.8. The level of general activity from sleep to highly active states is regulated by the neurochemical mechanisms. The activation pattern of the brain which can be recorded in brain waves during active states is maintained both by nerve impulses coming in over the sensory nerve tracts, and by neurochemical activation from lower brain centers concerned with motivation and emotion.

internal states which exist at the moment. Similarly, shifts in the hormonal balance modify behavior only in relation to sensory, neural, and muscular activity already in progress. Overt behavior—the response of the muscles themselves—is in one sense an end result and in another sense the start of new sensory input from the muscles to the brain.

HOW THE BEHAVING SYSTEM ORGANIZES ITS ENVIRONMENT

Individual behavior is under the influence of the environment, generally and specifically, but this influence is exerted in terms of the make-up of the human organism and its past history. Only a limited number of the endless variations in environmental energies—those to which the organism is sensitive—affect the living system as stimuli.

The way in which the movements and patterns of physical energy come to be organized as people, trees, tools, houses, heat and cold, pressure and pain, hinges upon the structure and functions of the living system. We say we see light and color in the world about us, but there is no light or color in the electromagnetic waves which stimulate the eye. We say we hear music and noises, but there is no tone or noise in the mechanical vibrations that stimulate the ear. Light, color, sound, smells, tastes, warmth, and cold exist not in the physical universe but in the behaving organism itself. The make-up of the individual determines what energies shall be received as stimuli, and then assigns to these stimuli special properties which give the physical universe its behavioral meanings.

Stimuli are defined as forms of physical energy having some direct effect on behavior through stimulation of receptor organs. There are two classes of stimulus conditions: general and specific. General stimuli include such conditions as temperature, humidity, atmospheric pressure, oxygen supply, and gravitational force. The body tolerates only limited changes in these general conditions. Changes in these aspects of the environment are motivating in character. For example, when the temperature drops, we move about or persistently seek means to keep warm. The many specific stimuli of the environment usually are identified with objects or events. Our traditional "five senses" are activated by light, sound, mechanical pressure, heat, and chemical substances which affect the organs of taste and smell. Perforating pressures producing pain are also an important class of stimuli.

How the Organism Defines its Stimuli. The effects of stimuli on the individual are defined primarily by the way the receptors operate, their location in the body, and the accuracy with which they provide information about the environment. Receptors are cells that can be activated by certain forms of physical energy, within well-defined limits. Many events in the physical universe go unnoticed by the unaided living system. We can "see" electromagnetic waves within a limited band, but we cannot see x-rays directly. We can "hear" the sound waves generated by our radio loudspeakers, but we cannot hear the radio waves which have carried variations in energy from the distant broadcasting source.

Some of the forms of physical energy which activate human receptor systems are indicated in Figure 4.9. To the left of the figure, we see a band of mechanical vibra-

tions of different frequencies. Part of this band, representing frequencies from about 16 cycles per second to about 20,000 cycles per second, activates the receptor cells of the human ear. In this range, we call mechanical vibrations *sound waves.* Some animals—dogs and bats, for example—give auditory reactions to wave frequencies far above the human range, so that what might be called "sound" for a dog is not necessarily sound for a man. At the lower end of the scale, mechanical vibrations with frequencies up to several hundred cycles per second can stimulate receptors in the skin, and are perceived as vibratory pressures. When mechanical vibrations of higher frequencies stimulate the skin receptors, they are felt as uninterrupted pressures. Airborne vibrations of ordinary intensities do not stimulate pressure receptors.

To the right in Figure 4.9, the electromagnetic spectrum is diagrammed. One very limited band of wavelengths activates receptors in the eye, and is known as the *visible spectrum.* Temperature receptors in the skin are stimulated by another limited band, the infrared rays. The skin can be burned by ultraviolet rays, but they do not activate receptors directly as stimuli. Certain electric waves, such as those used to light our houses, can stimulate many different receptors of the body.

Adequate and inadequate stimuli. The stimuli to which a receptor is especially sensitive are called the *adequate stimuli* for that receptor system. Thus, wavelengths from the visible spectrum are adequate stimuli for the eye, and sound waves are adequate stimuli for the auditory system. In some cases receptors can be activated by stimuli other than their adequate stimuli. For example, the eye can be stimulated electrically, and also by mechanical pres-

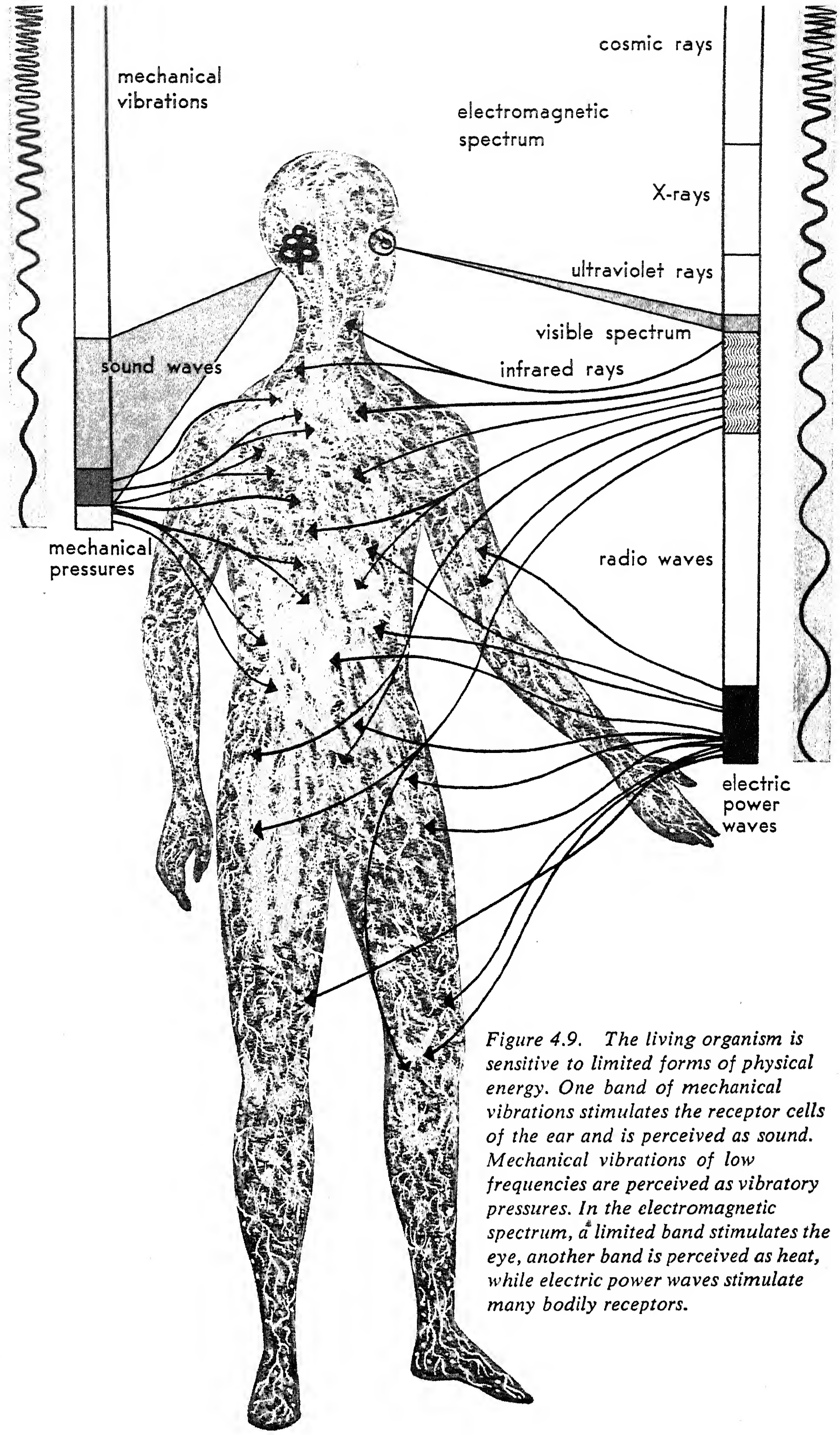


Figure 4.9. The living organism is sensitive to limited forms of physical energy. One band of mechanical vibrations stimulates the receptor cells of the ear and is perceived as sound. Mechanical vibrations of low frequencies are perceived as vibratory pressures. In the electromagnetic spectrum, a limited band stimulates the eye, another band is perceived as heat, while electric power waves stimulate many bodily receptors.

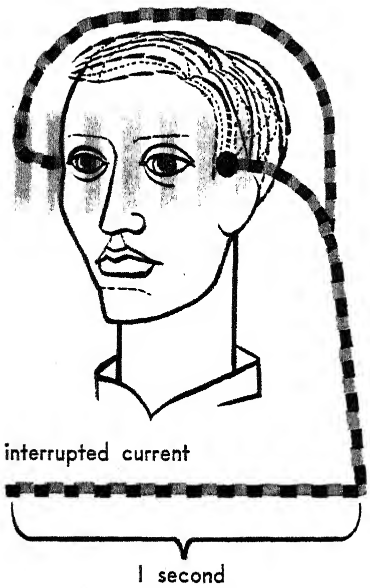


Figure 4.10. Visual response to inadequate stimulation. When the eyes are stimulated by a pulsating electric current, the subject perceives a flickering light which flickers at the same frequency as the current.

sure on the eyeball. We call this effect stimulation by *inadequate stimuli.*

Each receptor system responds in a characteristic way to the stimuli that excite it. Stimulation of the eye gives rise to perception of light and color, no matter whether the stimuli are waves from the visible spectrum, or electric waves, or mechanical pressure. If a taste bud in the mouth is stimulated electrically, the resulting perception is one of taste.

A demonstration of visual response to inadequate stimuli is shown in Figure 4.10. Small metal electrodes placed beside each eye of the subject are attached to a standard electric stimulator adjusted to produce a pulsating current. In this example, the current goes off and on twelve times per second. When the subject is stimulated by this pulsating electric stimulus, he reports a flickering light of the same frequency as that of the stimulus. If the frequency of the electric pulses is increased, the rate of the visual flicker also increases.

This experiment illustrates a fundamental principle about perception of the environment. A receptor system always responds in terms of its own special properties, irrespective of the properties of the stimulus acting on it. Historically, this principle of the specialized response of receptor systems is known as the *doctrine of specific nerve energies.*

Limits of response to stimuli. The receptors of the body are limited not only in the forms of energy to which they respond but in the amount of energy needed to activate them. Any given form of energy which stimulates a receptor needs to be present in a certain amount or at a certain minimal intensity. The lowest amount of energy which will excite a receptor system defines the stimulus *threshold* for that system. The threshold varies with all properties of the stimulus. Thus the amount of light needed to stimulate the eye is different with different wavelengths of light. The eye is relatively more sensitive to wavelengths at the center of the visible spectrum than at the ends.

Adequate and inadequate stimulation can be understood in terms of thresholds. The eye is organized to respond to very low intensities in the visible spectrum—that is, to its adequate stimuli. Although it is possible to stimulate the eye electrically or mechanically, it requires much more energy in these inadequate forms to produce a visual response.

Receptors are also organized to respond to *differences* in stimuli—differences in intensity, differences in wavelengths, differences in distribution or form. In all of these discriminations, a receptor system is more efficient when reacting to adequate rather than inadequate stimuli.

Sensory interplay. Some receptor systems —especially in the eye, the skin receptors, and the receptors in the muscles, tendons, and joints—are arranged so that they provide detailed information about the locus and pattern of stimulation. The eye is the most precise sensory system of all in this respect. Such information makes possible our perceptions of space and the form of objects. In a later chapter we shall see that the receptors, even the eye, do not reproduce the form and pattern of stimuli exactly. We often get somewhat different information about objects from different receptors. Thus an orange may *feel* larger than it looks.

The different receptor systems act together in highly integrated ways to regulate behavior. Our perception of an orange is a combination of information from the eye,

from the receptors of the skin, and from the sensory systems of the muscles, tendons, and joints of the hand.

Differential Responses to the Environment. What is the significance of the organization and differentiation of receptors for human behavior? How does the body utilize the ability of the eye to record millions upon millions of details in visual pattern and color? These questions touch upon one of the primary features of human behavior: the capacity of the individual to differentiate in perception the varied patterns of stimulation which affect the receptors, and to adjust his movements to these patterns.

Just think for a moment how important it is for us to be able to respond in a highly refined way to the variations in patterns of stimuli which reach the ears, the eyes, or the skin. When we read a book, our perceptions of words are based on the ability of the eye to distinguish each little form making up the letters of the alphabet. Furthermore, we are able to reproduce with the patterned motions of the hand each letter and word that we have read. The making and use of tools, the operation of machines, orientation in the environment, artistic creation, and most of the activities of interpersonal and social behavior depend on an appreciation of the form and pattern of stimulation and on the execution of motions which conform with high accuracy to these patterns.

Some common types of perceptual reactions and related patterned motions are shown in Figure 4.11. The weight lifter illustrates a point about the differentiation of motions that we often overlook: that the force of movement must be adjusted exactly to the weight of objects when we lift and handle them. The precision of the basketball player depends on visual differentiation as well as on a high degree of integration of the movements of the player's body, which enable him to shoot a basket from almost any position at one end of the court. The dancers illustrate the way in which human motions conform to perceptual discriminations—in this case, patterns of stimulation related to other people. The dance has its own rhythmic patterns, and each dancer executes the movements in such a way as to conform exactly to the movements of the others. The artist also shows how the human individual can reproduce in motion the form and pattern of stimuli in the environment. The technical skill of some artists is such that they can reproduce objects on a flat surface with such precision that they "fool the eye."

Understanding the interplay of receptor stimulation, general perceptual response, and the patterning of human motions presents many problems in the rapidly developing field of human engineering, or ergonomics. When a human body is used to operate a machine, the body, in effect, becomes part of the machine. A highly complicated, precise machine is of little use unless it can be used accurately and efficiently by the human operator. Many problems in this field are being investigated both for the armed services and for industry. For example, it is of utmost importance that the abilities and limitations of the human body be recognized in designing the pilot's space in an airplane. The movements required of him must be analyzed in order to arrange the controls in the most efficient way. The controls must also be arranged so that the pilot's split-second perceptual judgments be as accurate as possible. The "performance space" of the male human organism must be defined,

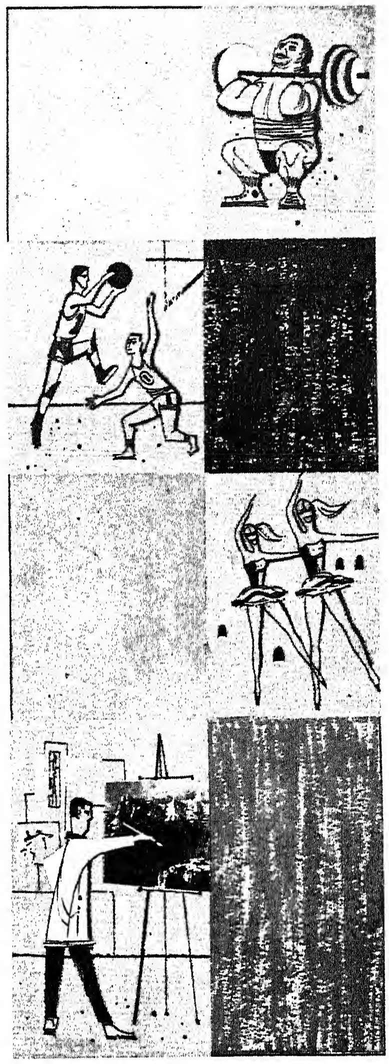


Figure 4.11. Highly differentiated perceptions of the environment make possible patterned movements. The individual is able to reproduce in skilled motions the patterns and differences that he perceives in the world about him.

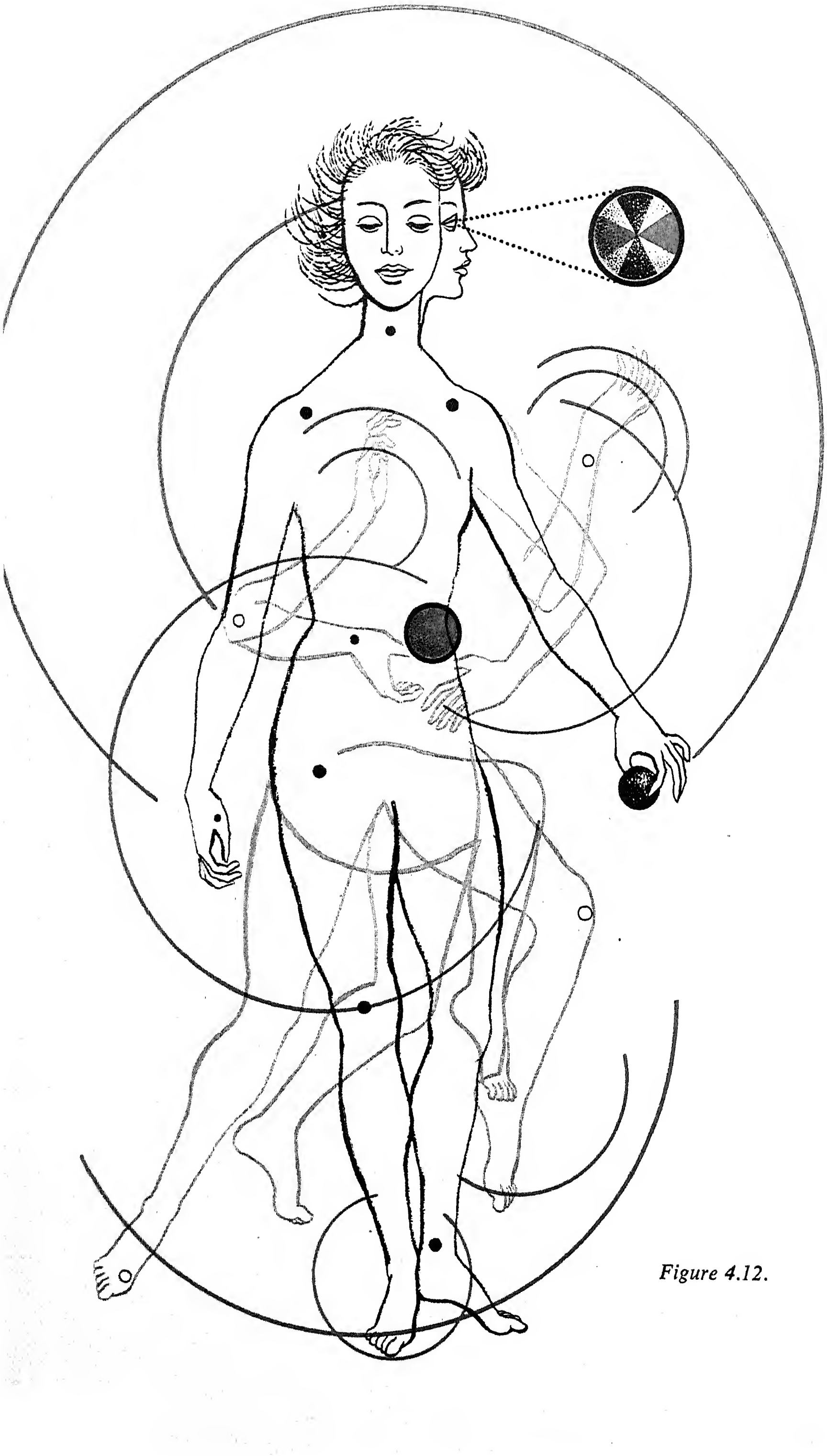


Figure 4.12.

when clothed lightly and also when covered by heavy flying equipment.

Some of the limitations imposed on human movements by the nature of the body structure are indicated in Figure 4.12. The eyes can see only in certain ways and in certain directions. The orbits of movement of the body (indicated by the circles) restrict the form, direction, and extent of response patterns. In order to make the movements of fingers, arms, or body correspond to stimulus objects—such as the ball held in the girl's hand—the organism patterns its movements according to its structural and physiological limitations.

Integration in the Behaving System. The organization and patterning of perception and motion are made possible by the highly refined coordinating functions of the nervous system. In contrast to the chemical regulating system, the nervous system provides for high *speed* in response as well as a high degree of *differentiation* in specific detail.

The nervous system is best understood as a specialized communication and governing system. It is organized so that it can receive a very large number of neural messages simultaneously from receptors all over the body, and at the same time transmit many messages outward over the motor pathways. Certain parts of the nervous system are given over to the transmission of these incoming and outgoing messages. Still other sections bring the different message-sending systems together and integrate their activities. The nervous system sends fibers to every receptor, muscle, and glandular cell in the body, and is continually receiving information about the state of affairs in the body as well as the external environment. Thus the neural messages

sent out to the responding organs provide for behavior that is adjusted to both body need and environmental stimulation.

Some of the important points about division of labor and integration of action in the nervous system are illustrated in Figure 4.13. The nervous system in this girl is being barraged continually by stimuli from the environment outside of and inside her body. At any given moment she reacts to only a few of the many incoming messages. Her overt activities are related to the surface on which she is walking and to the leash on her cat, but at the same time other chemical and neural signals transmitted through the nervous system regulate the beating of her heart, the processes of digestion, and the levels of general activity in her muscles. Many of the incoming sensory messages are blocked or *inhibited* in the central nervous system.

The division of labor and integrative action of the central nervous system consists also of channeling activity outward through specific motor paths. This differential control is an outcome of the coordinated action within the nervous system, whereby it can regulate many motor and glandular activities simultaneously. Thus the girl in Figure 4.13 can at the same time walk along, turn her head this way and that, hold the leash, listen to the purring of the cat, and speak its name.

Much of our behavior involves the bringing together or integration of separate neural and chemical activities of the body. As we have said before, even our perception of common objects combines the effects of visual and tactual stimulation with sensory messages received from the muscles, tendons, and joints. The flavor of most of our foods combines both taste and smell. It is this remarkable integrative action, this

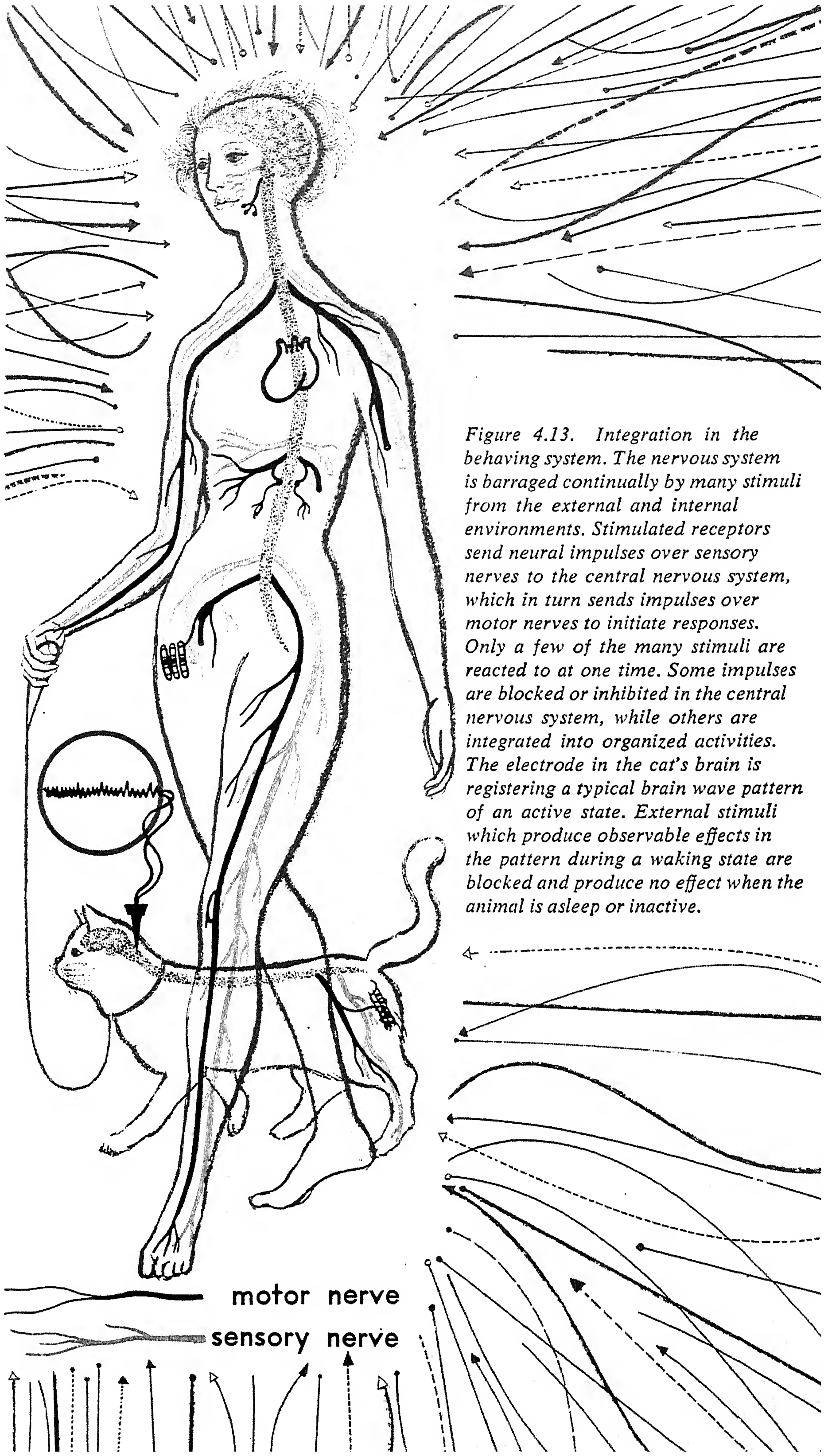


Figure 4.13. Integration in the behaving system. The nervous system is barraged continually by many stimuli from the external and internal environments. Stimulated receptors send neural impulses over sensory nerves to the central nervous system, which in turn sends impulses over motor nerves to initiate responses. Only a few of the many stimuli are reacted to at one time. Some impulses are blocked or inhibited in the central nervous system, while others are integrated into organized activities. The electrode in the cat's brain is registering a typical brain wave pattern of an active state. External stimuli which produce observable effects in the pattern during a waking state are blocked and produce no effect when the animal is asleep or inactive.

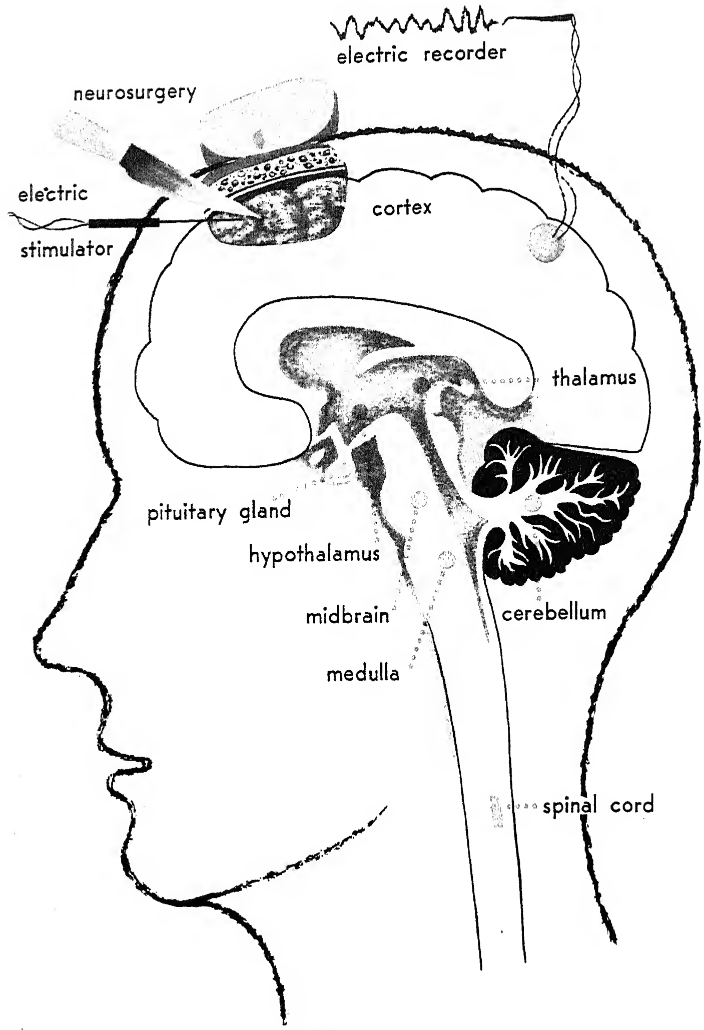


Figure 4.14. The main divisions of the central nervous system, with the pituitary gland near by. Three methods of studying localization of function in the brain are by neurosurgery, electric stimulation of specific areas, and electric recording of brain activity.

fusion of separate processes to produce a unified effect, which underlies all perception, coordinated skilled motion, learning, thinking, and the organized responses of the individual in adjustive behavior.

Division of Function in the Nervous System. Figure 4.14 represents a view of the human brain as it would appear if cut in half along the midline separating right from left. Here we see again the regions of the brain near the pituitary gland which we noted as primary centers for the control of activity level. The first of these regions we learned was the hypothalamus. The second is located in the division of the nervous system called the *midbrain.* The four other main divisions of the brain shown are the *cerebral cortex,* the *cerebellum,* the *thalamus,* and *medulla.* The general area of the thalamus includes the hypothalamus and another part which receives sensory nerves from all over the body. The medulla is the portion of the stem of the brain just above the spinal cord. Besides carrying the nerve fibers of the cord, it is important also in regulating activity, particularly the vital activities related to circulation, breathing, and control of body temperature.

The cerebral cortex and cerebellum play vital roles in integrating many kinds of behavior. The cerebellum can be thought of as essentially a timing mechanism for all types of body movements. Injuries to this region can cause disturbances in the timing of both simple and complex motions, even those of speech. Marked tremors or jittering movements may occur as a permanent result of cerebellar injury. The cerebral cortex is a folded covering of the brain, with its folds giving it a convoluted appearance. It organizes space-wise the activities of the body in learning, perception, and motion, in contrast to the timing functions of the cerebellum. In the cerebral cortex we find areas devoted to the integration of activities of the major sensory systems of the body, and of the highly skilled motions of hands, feet, face, and tongue.

Figure 4.14 also shows some of the methods that are used to analyze the functions of the nervous system. One method is to observe the effects of removal of certain

regions of the brain upon behavior of the animal or individual. Observations of this sort can be made on the human individual when tumors are removed from the brain or when other surgery is undertaken for medical reasons. The method of electrical stimulation can be used to explore both sensory and motor functions of the neuromuscular system. In investigating motor functions of the cerebral cortex, a stimulus is applied and observations made of the movements that occur as a result. We can also record electrical activity of human and animal brains to study localization of functions. Electrodes are placed on the head or on the brain and a stimulus is then applied to a receptor or to another part of the nervous system. By recording activity that occurs under the electrode, we can tell if this particular part of the brain is related to the sensory process stimulated.

The photographs in Figure 4.15 represent actual studies of brain function. In Figure 4.15*a* we see the brain of a monkey exposed in an aseptic, or germ-free, operation performed to remove part of the cerebral cortex. The piece of brain on the gauze pad in Figure 4.15*b* is the section of cortex actually removed in the operation. By examining the area of the operation, we can see how the cerebral cortex forms a covering over the rest of the brain. When the animal recovered from this operation, it was carefully studied to compare its perceptual and motor reactions with those occurring prior to the operation.

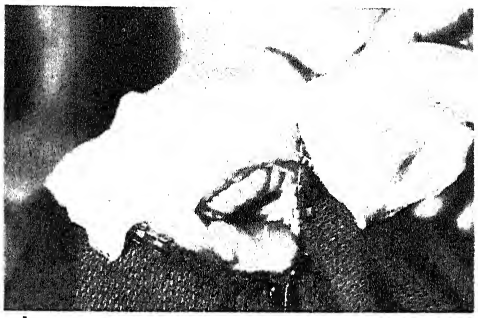
When posterior parts of the cortex known as the visual areas are removed in a cat, dog, or other animal, the animal does not become completely blind. It can still discriminate intensities of light, but not single objects or specific patterns. We say that it lacks object vision. Such experiments illustrate what we noted above: that a principal function of the cerebral cortex is to regulate perception and motion in relation to objects in space.

We often observe similar disturbances of function when the human brain is injured. Figure 4.15*c* shows the brain of a young man hurt in an auto accident. The posterior, or *occipital,* region of his left cerebral cortex was injured in the accident and later partially repaired through surgery, but since nerve cells in the human brain never grow again, the defect remained in the brain, as shown. Following his injury, this man was found to be blind to specific stimuli in the left half of both his eyes. Thus in the cerebral cortex there is not only a general localization of different activities, but the two sides of the body and of some body organs are represented in different halves of the brain.

Figure 4.15*d* shows in detail the convolutions of the cerebral cortex and its very rich blood supply. This is a photograph of the living brain of a chimpanzee, which at the time was a subject in extensive studies of brain function by means of electrical recording and stimulation of the brain. From such studies we now know that there are many different or duplicate ways in which parts and functions of the organism

a

Figure 4.15. a, b. *A part of the cortex is removed from a monkey's brain.* (Courtesy the late Dr. Paul H. Settlage.) c. *A human brain damaged in an accident, with resulting visual deficiencies.* d. *The living brain of a chimpanzee, exposed for stimulation studies.* (Courtesy Dr. Clinton N. Woolsey.)



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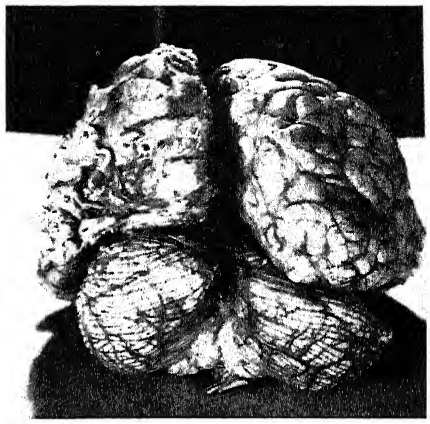

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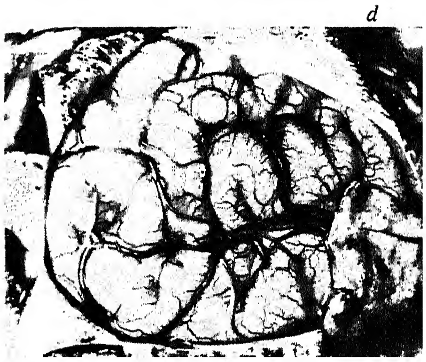


are represented in the cerebral cortex and cerebellum, but we do not know how these duplicate representations are interrelated to carry out the complex integrative actions of the brain.

The cerebral cortex is organized primarily to govern the more refined motions of the body. One kind of evidence for this conclusion is derived from the known facts of localization of motor functions in the brain. The little half-men shown in Figure 4.16 are obviously not a true representation of the human body. They are, however, a relatively true representation of the extent to which the different parts of the human body are represented in the *primary motor areas* of the cerebral cortex. In other words, the motor system of the cerebral cortex, as indicated by the small circular areas shown in the brain, is mostly devoted to the control of the eyes, tongue, jaws, lips, hands, and big toes. The hand and face areas together account for the major part of these motor regions. Thus we say that the primary motor areas of man's cerebral cortex are devoted mainly to the regulation of the high-precision motions of the face, tongue, and hands, and to a lesser extent to control of the larger movements of the body.

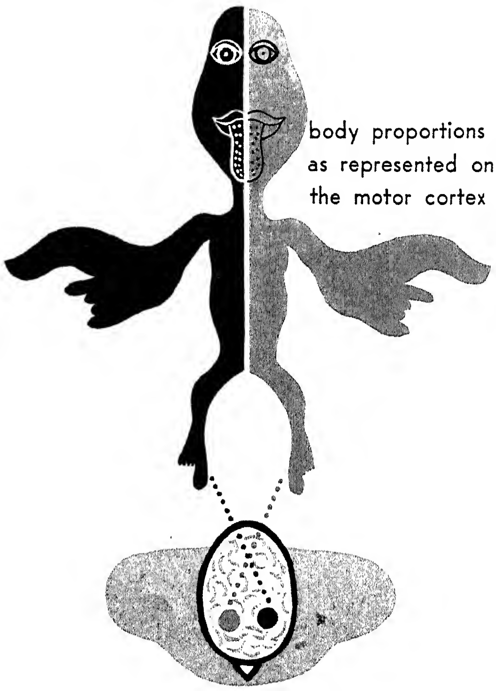


Figure 4.16. Representation of motor functions in the cortex. The half-men show the extent to which different parts of the body are represented in the primary motor areas of the cortex. Most of this area is given over to regulation of the movements of the eyes, tongue, jaws, lips, hands, and big toes. Each half of the body is represented on the opposite side of the brain.

The division of function in the different regions of the human cerebral cortex, as seen from the top, is shown in Figure 4.17. If we take the large central *sulcus* (groove) going across the middle of each hemisphere as a guide, it is fairly easy to remember how the whole body is represented on the brain. Motor functions, as described above, are represented just in front of this main sulcus. In this area, the right side of the body is represented on the left cortex, and the left side of the body on the right cortex. Still farther forward are the *frontal lobes*, the mystery mechanisms of the cortex. This portion of the brain is related to emotion and motivation. All of the internal organs of the body probably have specific representations in the frontal lobes.

The regions of the cortex back of and below the central sulcus are concerned with integration of sensory activities. Nerve channels from all the main receptor systems of the body converge here. Large areas are given over to the sensory channels of vision and hearing. In a still larger area, the region just behind the central sulcus, sensory functions of specific parts of the body are represented. These cortical areas of body sensitivity reproduce the general outline of the limbs, trunk, and head, with the face and hands represented in relatively larger areas, as in the primary motor areas.

The localization of behavioral functions

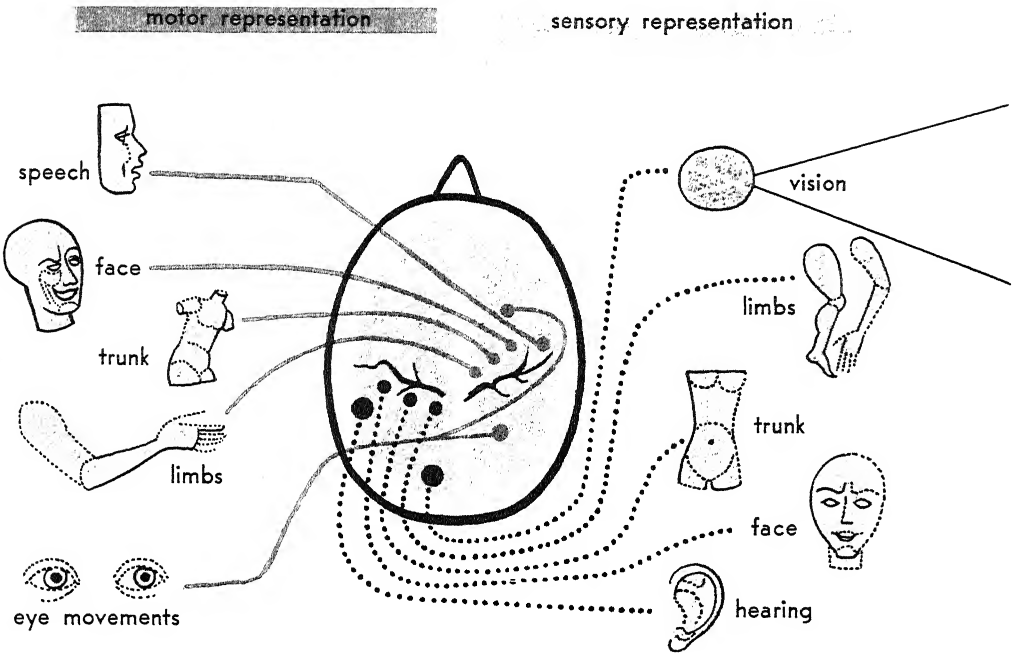


Figure 4.17. Division of function in the cerebral cortex. The motor areas are indicated on the right cortex, representing the left side of the body. The sensory areas are indicated on the left cortex. Not much is known of division of function in the frontal lobes, although the internal organs probably are represented there.

in the central nervous system gives us some clues about the organization and regulation of behavior patterns. Although the sensory and motor systems have specific representation within the cerebral cortex, we find no parts of the brain devoted specifically to personality traits, intelligence, or other general abilities. There are no special regions which appear to be developed more in one person than in another. We find no particular systems that carry out learning functions, nor can we localize thinking functions. We find neither television receivers nor computing machines inside the brain. We do observe that it is a complicated system, still mysterious in many ways, in which there is division of labor but also an overall integration of activities. The unity of behavior in the individual reflects the total organization of all parts of the response mechanism.

MECHANISMS OF SPECIFIC RESPONSE

The behavior of the living organism includes various types of activities—postures, skilled motions, sustained glandular secretions, and reflex movements. All of these actions involve stimulation, neural conduction, neural integration, and motor action, either in the form of muscular contraction or glandular secretion. All of them are defined by the specific properties of the response mechanism.

In order to understand the detailed stages involved in behavior, it is sometimes desirable to direct attention to restricted forms of response. Thus we can arbitrarily isolate specific movements and determine by experimental observations what goes on in the receptors, nerves, and muscles which control these reactions. In

this section we shall consider some of the known properties of specific response.

Reflex Movements. Reflexes are restricted forms of movement or glandular response, consistently related to specific forms of stimuli, which may serve as protective acts, as defensive emotional responses, or in postural adjustments of the organism. Reflex movements are not usually organized in a definite way in relation to the form and pattern of stimuli, but they are often correlated in strength to the intensity of stimulation—that is, the greater the intensity of stimulation eliciting the reflex, the stronger the response.

The reflexes shown in Figure 4.18 are important in psychology because they are frequently studied in relation to learning, development of behavior in infancy, or perceptual activities. The withdrawal reflex, the knee jerk, the pupillary reflex, and the eyelid reflex have been investigated often in learning experiments. The Babinsky reflex—the fanning of the toes when the sole of the foot is stroked—and the Moro reflex are seen only in infants and indicate the level of development of behavior. The Moro reflex is a convulsive throwing back of the arms and head elicited by a sudden loud sound or some jarring movement. Eye movement reflexes are especially interesting and informative. We record these reflexes in the study of reading, in observations on movement perception, and in the investigation of applied problems of advertising and the factors of attention.

When we diagram a reflex, such as the withdrawal reflex shown in Figure 4.19, we can identify five main stages of activity within the body: (1) activation of the receptor; (2) sensory nerve conduction;

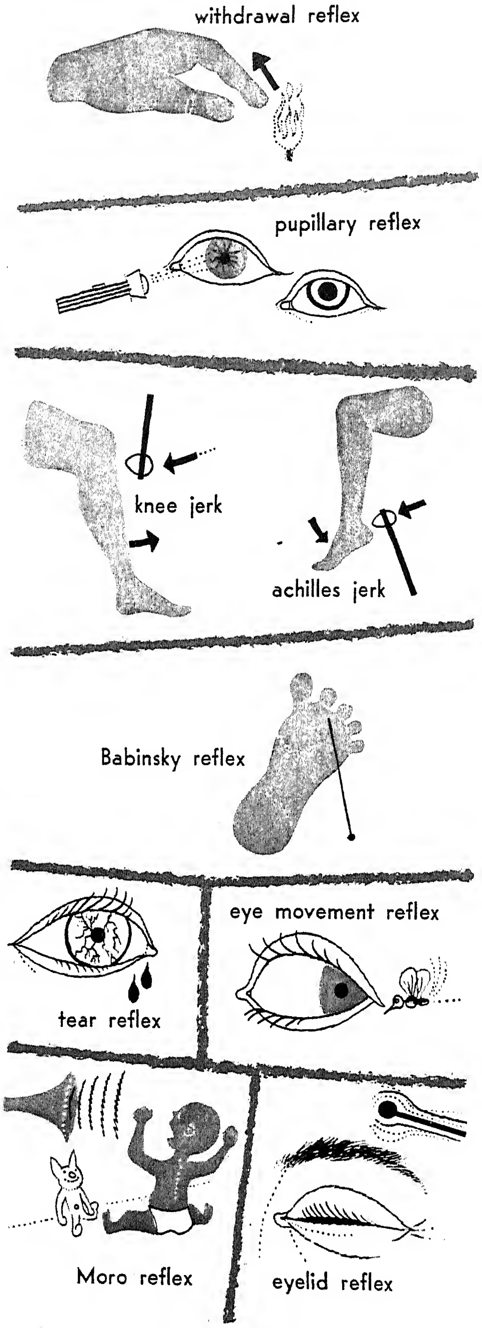
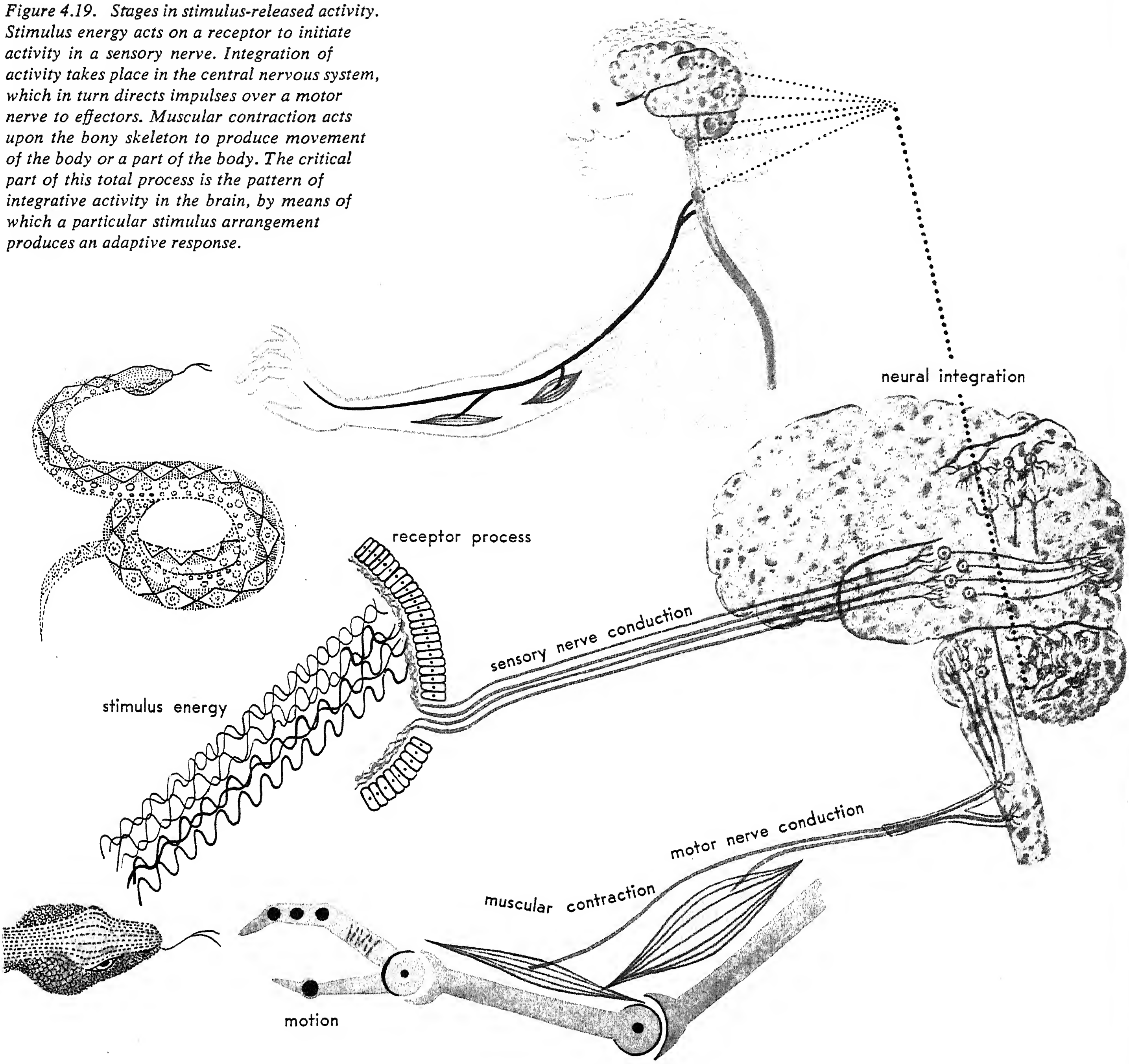


Figure 4.18. Some typical reflexes of the human individual. The Babinsky and Moro reflexes are seen only in infants. Reflexes are primitive responses serving protective or defensive purposes, or in postural adjustments. They are usually correlated in strength with the intensity of the stimulus.

Figure 4.19. Stages in stimulus-released activity. Stimulus energy acts on a receptor to initiate activity in a sensory nerve. Integration of activity takes place in the central nervous system, which in turn directs impulses over a motor nerve to effectors. Muscular contraction acts upon the bony skeleton to produce movement of the body or a part of the body. The critical part of this total process is the pattern of integrative activity in the brain, by means of which a particular stimulus arrangement produces an adaptive response.



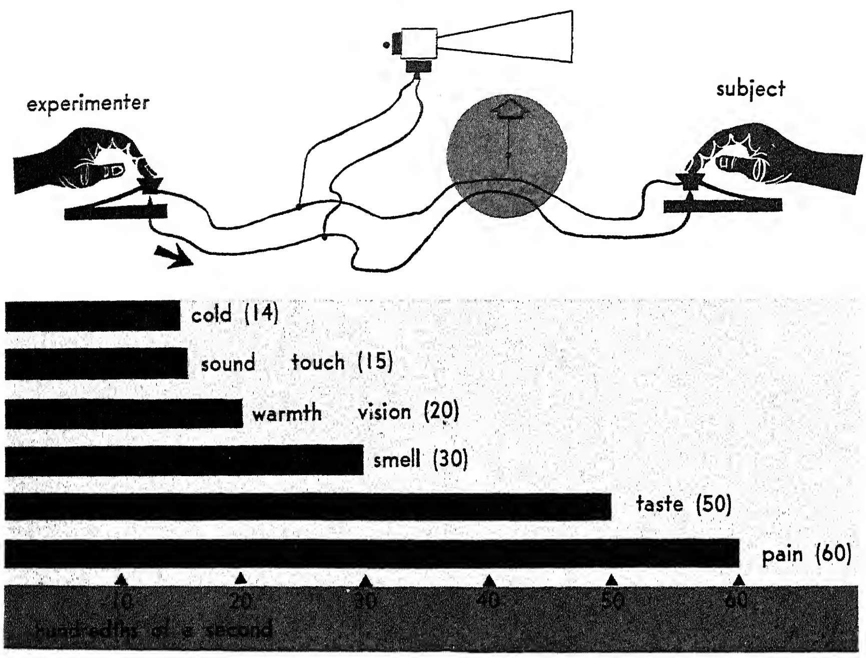


Figure 4.20. Typical simple reaction times to different kinds of stimuli. The experimenter gives a stimulus and starts a time clock by pressing his key, and the subject stops the clock by releasing his key as soon as he perceives the stimulus.

(3) central nervous system integration; (4) motor nerve conduction; and (5) motor, or effector, action. The first stage, the activation of the receptor, involves the transformation of energy from the environment into neural energy by means of the receptor process. Neural impulses proceed through the central nervous system by different routes, involving different centers according to the type of response required. In the last stage of the response sequence, neural energy activates the cells of the effector organ, either muscle or gland, to complete the response.

Reaction Time. When we isolate and study specific response, we observe that any response of an organism to a stimulus requires a finite, measurable period of time. Response times vary from one type of reaction to another because of the varying durations of the five stages shown in Figure 4.19. Some sensory processes are faster than others, and some forms of response are faster than others. It is the pathway through the central nervous system, however, which is the principal variable in a response sequence.

One method for measuring reaction time is diagrammed in Figure 4.20, along with some typical reaction times for different kinds of stimuli. Simple reaction times can be measured by a precision time clock, started and stopped by telegraph keys. The experimenter presses a key which presents a stimulus such as light or sound to the subject, and simultaneously starts the clock. The subject releases his key as soon as he observes the stimulus—that is, as soon as he sees the light or hears the sound—thus automatically stopping the clock. The interval of time recorded on the clock is his reaction time for that particular stimulus-response situation.

The typical reaction times to different kinds of stimuli may come as some surprise. Notice that the simple reaction time to pain is very long, about .6 second. The reaction time to cold, touch, or sound is about one fourth this value. If the subject is required to discriminate between two stimuli before responding, his reaction time is longer than in simple reactions. Discrimination reaction times usually vary from .2 to .5 second for visual or auditory discriminations. When the subject is required to respond by speaking a word to a stimulus word, the reaction time is quite long and may exceed 1 second, depending on the words used. We refer to such verbal reaction time as *association time*. Discrimination and association times are longer than simple reaction times because of the longer time required in the central nervous system.

Receptors and Effectors. Figure 4.21 describes the main classes of receptors and effectors in the human body. There are three general types of receptors: *exteroceptors, proprioceptors,* and *interoceptors.* In the figure, we show the eye and a skin receptor as types of exteroceptors. The ear and the receptors of taste and smell are also classed as exteroceptors. These receptor organs record information about the external environment. Proprioceptors, or *kinesthetic receptors,* give information of bodily position and movement. One type is located in the muscles, tendons, and joints, as shown. Another type of proprioceptor is located in the static mechanisms of the inner ear, which are sensitive to the pull of gravity and to movement of the body in space. Interoceptors, so called because they record the internal environment, are located in the visceral organs or cavities of the body. Two types of these receptors are shown on the left side of the figure: a free nerve ending in the gut, and a pressure receptor in the connective tissue of a blood vessel. Free nerve endings are also found among the exteroceptors and proprioceptors. Their stimulation may produce pain.

The responding organs of the body are the effectors, including muscles and glands. We have already learned something about the ductless glands—those that secrete hormones directly into the blood stream. Duct glands, such as salivary and tear glands, also function as effectors.

The muscles of the body are of three types: the *striped muscles* usually attached to the skeleton, the *smooth muscles* of the viscera, and the heart muscles. Skeletal muscles are typically arranged in pairs, as in the case of the biceps and triceps muscles shown in the right arm in Figure 4.21. In moving the arm, they work in opposition

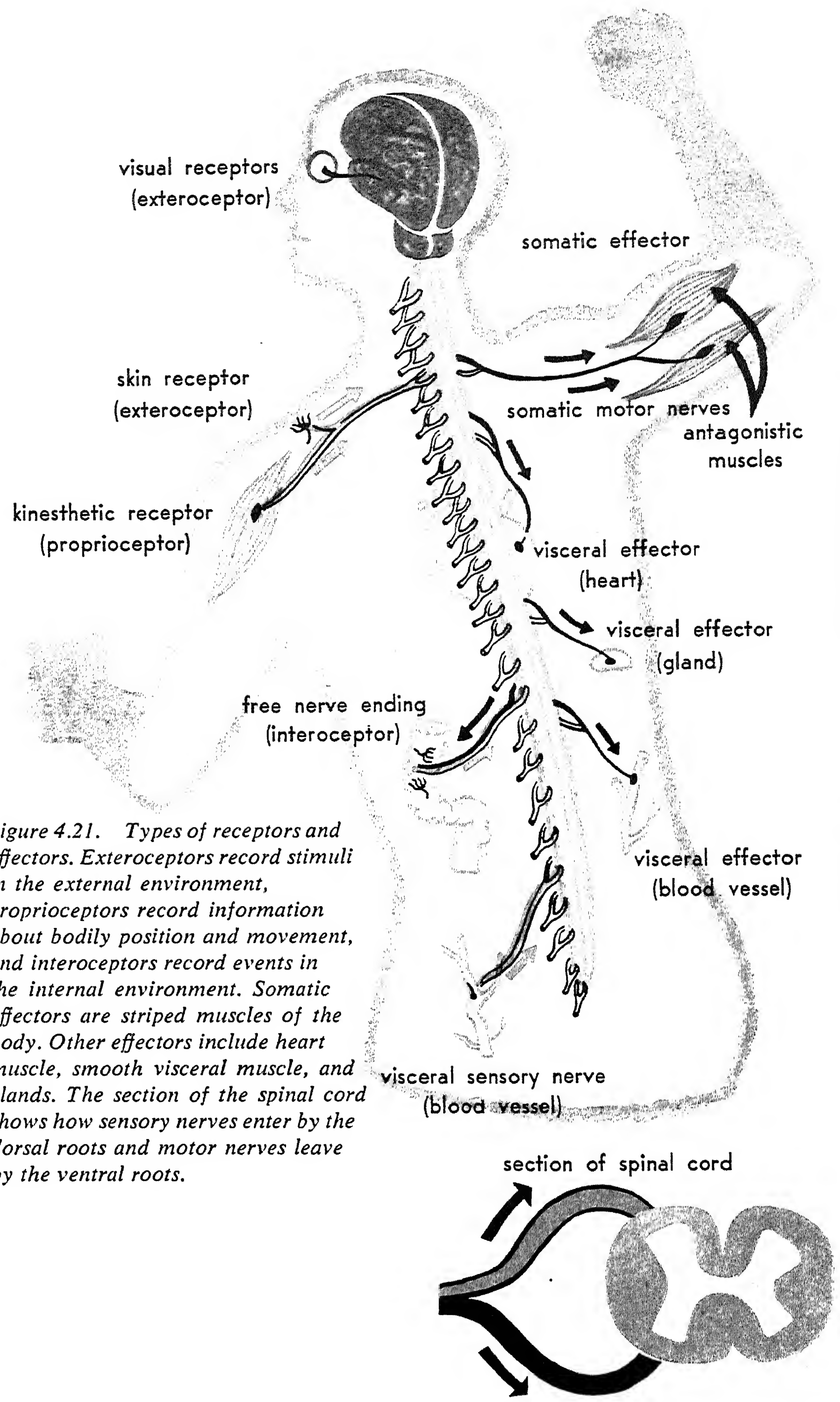


Figure 4.21. Types of receptors and effectors. Exteroceptors record stimuli in the external environment, proprioceptors record information about bodily position and movement, and interoceptors record events in the internal environment. Somatic effectors are striped muscles of the body. Other effectors include heart muscle, smooth visceral muscle, and glands. The section of the spinal cord shows how sensory nerves enter by the dorsal roots and motor nerves leave by the ventral roots.

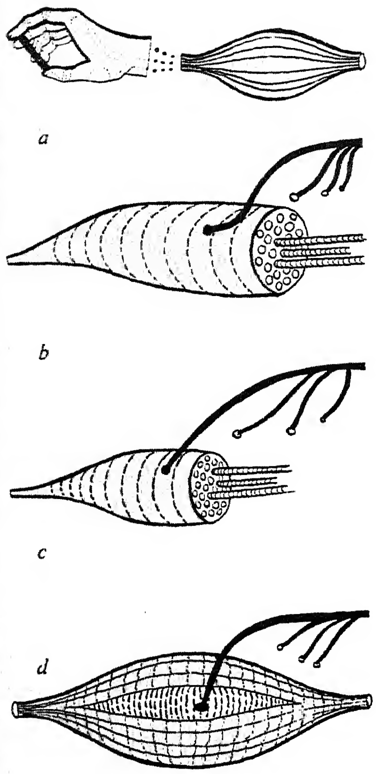


Figure 4.22. a. *Striped muscles are made up of bundles of muscle fibers.* b. *A single muscle fiber looks striped under a powerful microscope, and small fibrils can be seen.* c. *When it contracts, it contracts to its maximum extent.* d. *The force of the total muscular contraction is determined by the number of fibers contracting.* (Modified from Huxley, H. A. Muscular contraction. *Endeavour,* 1956, **15,** 177–188.)

to one another. This opposed action is a reciprocal process in which one muscle is contracted and the other simultaneously inhibited or blocked in its action by the central nervous system. We call this opposed action the reciprocal innervation of antagonistic muscles. Its effects can be observed in tremor movements. If you extend your arm horizontally and attempt to hold it still, you probably can see a tremor in your fingers. This oscillation is due to the alternate contraction and inhibition of opposed muscle groups supporting the arm.

How Muscles Work. The force, precision, timing, and magnitude of movements are defined in part by how muscles actually work. A small bundle of single muscle fibers from a larger muscle is shown in Figure 4.22*a*. Each of these fibers is attached to a tendon, which in turn is attached to a bone, so that the contraction of the fibers will exert a force on a movable part of the skeleton. If we take a piece of skeletal muscle and look at it under a powerful microscope, we can see single striped muscle fibers, such as shown in Figure 4.22*b*, each with a nerve fiber attached to it. Nerve impulses cause the fiber to contract by releasing a chemical substance at the point of attachment.

Single muscle fibers follow what we call the *all-or-none principle* of reaction. When one of the fibers in a bundle is excited and contracts, it contracts to its maximum extent (Fig. 4.22*c*). Thus the strength or force of movement is not a function of the degree of contraction of individual fibers. Rather, the force of the total contraction of a muscle is determined by the number of fibers which are contracting at any given time in the bundle making up the total muscle (Fig. 4.22*d*).

The Receptor Process. The receptor process consists of two main phases of activity: the action by means of which the receptor cell is stimulated, and the stimulation of the attached nerve. In the first phase, the stimulus energy in some way alters the receptor cell; in the second, the receptor cell sets up nerve impulses in its attached nerve fiber.

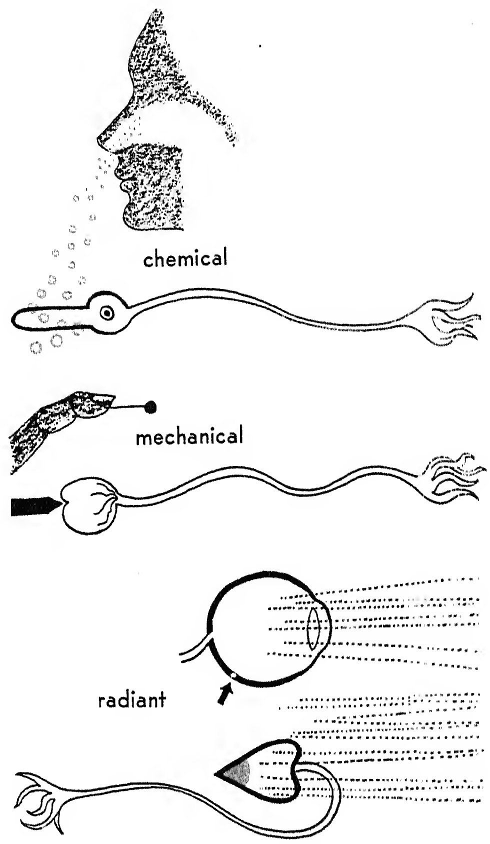


Figure 4.23. The receptor process. Stimulus energy initiates activity within the receptor cell, which in turn sets up nerve impulses in the attached nerve fiber. Both chemical and electrical changes are involved.

Figure 4.23 describes diagrammatically the general processes believed to occur in chemical stimulation of olfactory receptors, in mechanical stimulation of pressure receptors in the skin, and in stimulation of the receptor cells of the eye by light. In the first case, the chemical molecules are believed to enter the rodlike portion of the olfactory cell and initiate the receptor activity. When pressure receptors are stimulated, the mechanical pressure deforms the receptor cell and causes it to release energy. Stimulation of the receptors of the eye involves a photochemical reaction. The radiant energy is absorbed by light-sensitive substances of the receptor cells, bringing about a chemical breakdown of these substances. This chemical change, in turn, stimulates the nerve fibers attached to the cells.

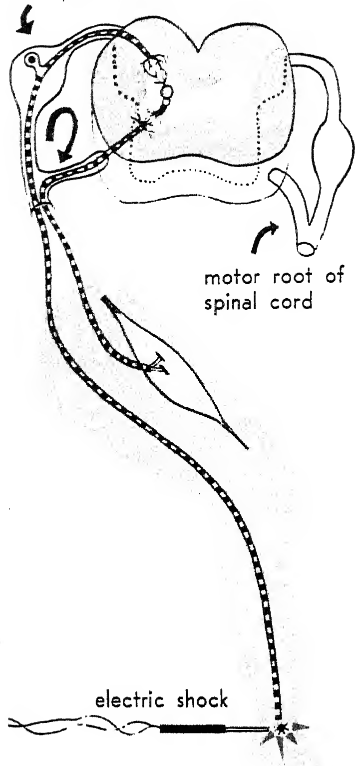
We still do not know exactly how different receptor cells stimulate the nerve fibers attached to them. In the simplest receptor, the free nerve ending for pain, the stimulus energy acts directly on the nerve to initiate neural impulses. In specialized receptor cells, the effects produced by stimulus energy result in changes in the electrical state of the nerve fiber at the point where it joins the receptor cell. Once the local electrical state at this junction builds up to a certain threshold level, a nerve impulse is initiated.

Neural Conduction. A nerve impulse is a local electrochemical change which moves along the nerve fiber. Although this impulse is electrical in nature, it is not equivalent to an electric current. For one thing, neural conduction is much slower than an electric current. In the last century it was thought that nerves conduct with the speed of light, but we now know that they carry impulses at speeds from about 1 to 100 meters per second.

A single impulse in a nerve fiber is in one way like the contraction of a single muscle fiber—that is, it represents the all-or-none reaction of a single cell. The impulse can occur at only one strength; it either occurs or it does not. Differences in intensity of stimulation can be represented in a single nerve fiber, however, by the *frequency* at which impulses occur. Within certain limits, the greater the intensity of the stimulus, the higher the frequency of impulses discharged along the fiber. There are different types and sizes of nerve fibers which can discharge at different rates. The largest ones can carry impulses up to a frequency of about 1000 per second.

The total nerve impulse in a nerve is a combination of the all-or-none responses of all the *neurons* (single fibers or cells) making up the nerve. Some nerves contain many thousands of single neurons, which vary in their sensitivity. As stimulus intensity increases, more single fibers react, and the active fibers discharge at higher frequencies. Thus the total amount of activity in the nerve, depending as it does on the combined frequencies of discharge of all the active fibers, reflects the level of stimulus energy.

Communication and Integration in the Central Nervous System. The structural units of the nervous system are single nerve cells, or neurons. A single *sensory neuron* typically extends from a receptor to the central nervous system; and a single *motor neuron,* from the central nervous system to an effector. Individual nerve fibers are elongated extensions of single living cells. In the central nervous system, sensory neurons make connections with motor neurons



by means of one or more intermediate cells, known as *association neurons.*

A simple reflex arc is diagrammed in Figure 4.24, showing the relationships between the three kinds of neurons. Such a simple arrangement is a theoretical possibility but does not exist in ordinary behavior. As a rule, many more neurons are involved, especially in the central nervous system, where the interconnections provided by association neurons may be quite complex.

Individual neurons begin and end in treelike ramifications, such as those shown in Figure 4.24. The gap which exists between one neuron and the next is known as the *synapse*. Communication within the central nervous system shows certain differences from that in peripheral nerves because it is in very large part defined by transmission of messages across these synapses. Some of the secrets of the way we learn, the way we think, and of other important integrative actions associated with behavior are a part of the enigma of synaptic communication.

Synaptic conduction of neural messages probably involves the processes shown in Figure 4.25. When impulses reach the end of the neuron at the synapse, they may release chemical substances (Fig. 4.25*a*) or change the electrical state at the synapse (Fig. 4.25*b*). In the process of chemical mediation, the first fiber releases the mediator substance, which in turn excites the next neuron. Chemical mediator synapses probably exist in all the parts of the nervous system related to regulation of the glandular system. The synapses related to receptor-neuromuscular action probably act more rapidly by means of the electrical type of synaptic conduction, in which the electric field set up by the first impulse initiates a new impulse in the next fiber.

It is believed that some nerve fibers in the hypothalamus influence other nerve

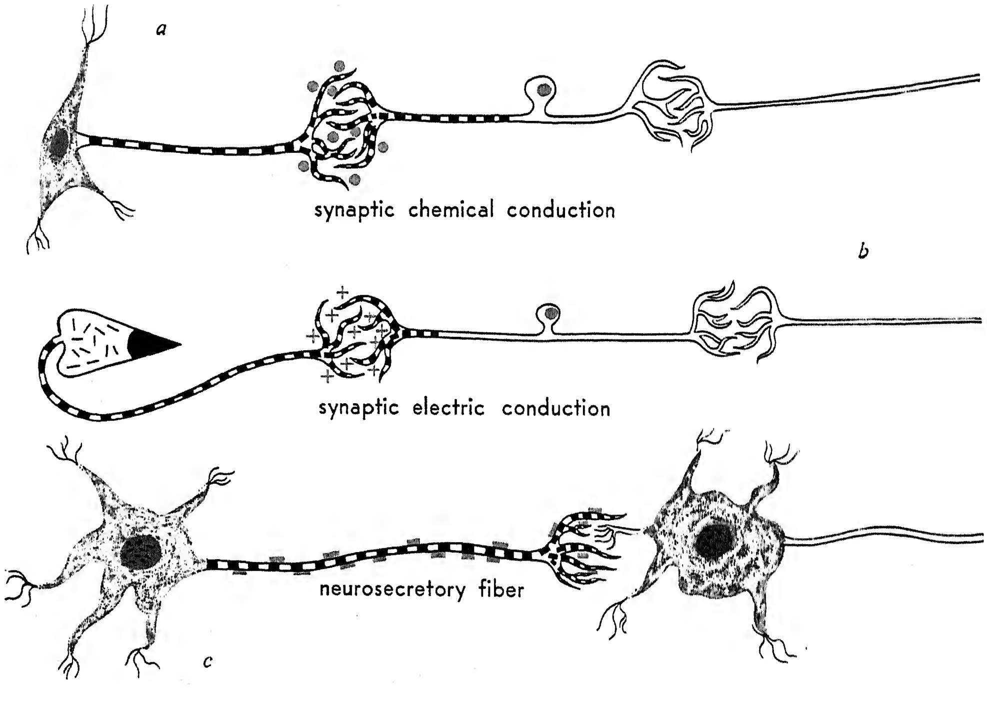


Figure 4.24. A simple reflex arc. The simplest kind of reflex would involve a sensory neuron, an association neuron in the central nervous system, and a motor neuron leading to an effector. The broken lines indicate chains of impulses discharging along the nerve fibers.

Figure 4.25. Types of synaptic conduction. Synaptic communication is a one-way process which may be chemical, electrical, or both. Some fibers in the hypothalamus influence other nerves by secreting chemicals along their length.

fibers not only by synaptic conduction but by releasing chemicals along their length (Fig. 4.25*c*). We mentioned this kind of neural-chemical transmission earlier in connection with the integration of general activity level, emotion, and motivation.

Through the work of Sherrington, we have known for years how specific movements are coordinated through synaptic communication in the nervous system. The messages of many neuron channels are brought together at synapses, as suggested by the diagram in Figure 4.26. The paths activated beyond these message centers depend on the state of the synapse, the amount of activity coming in over different input paths, and the previous action of the center. Synaptic communication establishes one-way conduction from the sensory side of the response mechanism to the motor side. Single neurons can conduct impulses in either direction, but in the synaptic network, messages go in only one general direction, from the receptors toward the effectors.

Both temporary changes in behavior, as in fatigue, and persisting changes, as in learning, are believed to be very largely a matter of chemical change in synaptic systems. Memory must involve changes in the synaptic centers which permit enhancement of one type of learned response over another response learned less well. These changed synaptic states persist so that relationships between incoming sensory signals and motor output are altered.

There are still other aspects of behavior which are due to the organization of synaptic communication. As shown in Figure 4.26, one train of impulses, such as those from CNS input 3, can dominate a synaptic junction and control the motor output. In

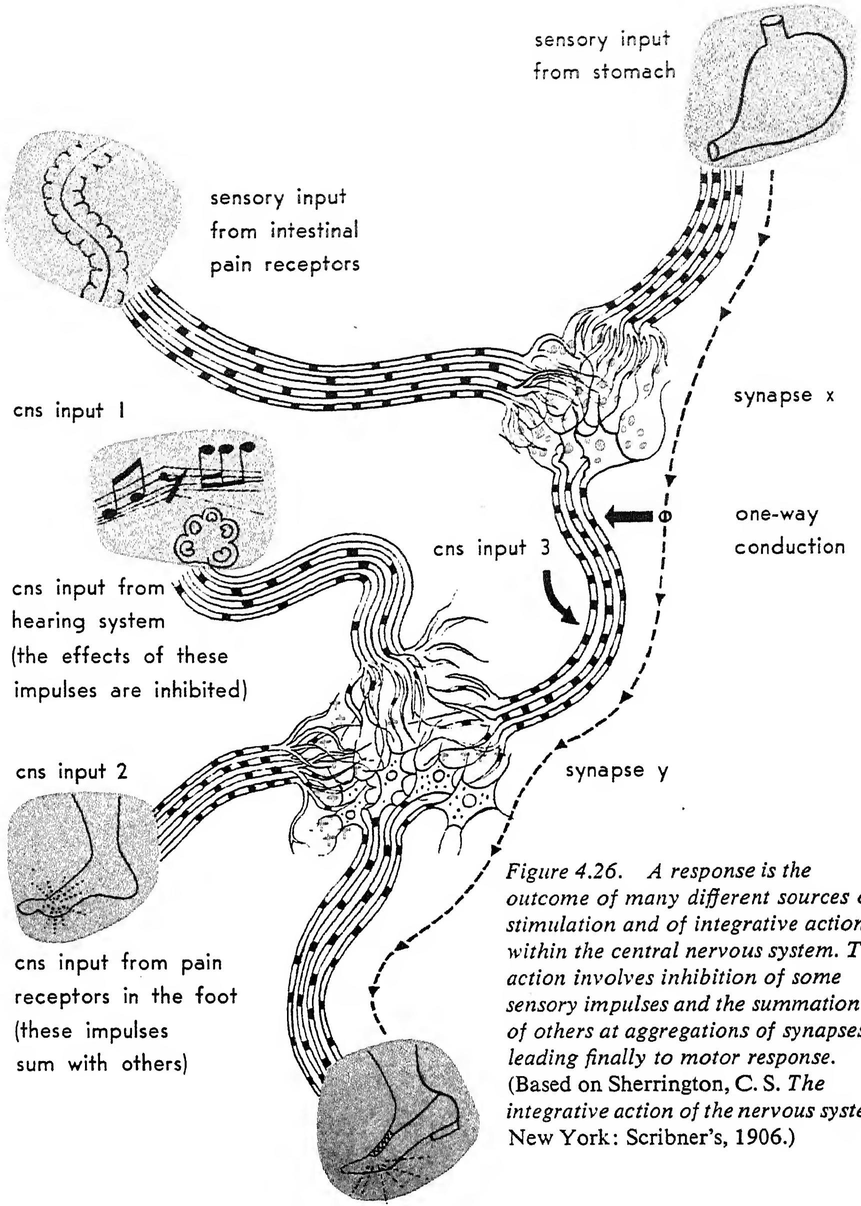


Figure 4.26. A response is the outcome of many different sources of stimulation and of integrative action within the central nervous system. This action involves inhibition of some sensory impulses and the summation of others at aggregations of synapses, leading finally to motor response. (Based on Sherrington, C. S. *The integrative action of the nervous system.* New York: Scribner's, 1906.)

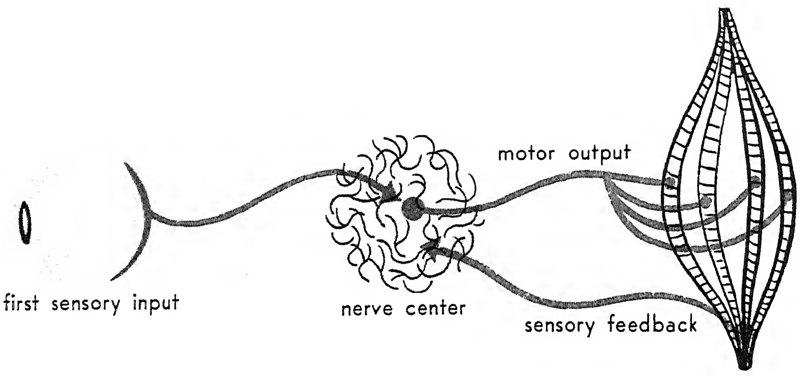


Figure 4.27. The role of sensory feedback in the regulation of sustained activity. The first sensory input initiates a movement, and sensory feedback from the responding organ serves to correct, redirect, and pace the movement.

this case, impulses coming in over inputs 1 and 2 would be prevented or blocked from affecting the response. This inhibitory effect, or *neural inhibition* as it is called, is essential in motor coordination and helps explain the reciprocal innervation of muscles, as described above. In the process of activation of one of the antagonistic muscles of a pair, the other is actively inhibited by the synaptic motor centers. In contrast to inhibition, two input neuron paths can summate or reinforce each other through their combined effect on the synapse, as shown by the enhanced limping in Figure 4.26. Moreover, we have good evidence that the whole pattern of communication in the nervous system may be governed by the distinct effects of body chemicals on the synaptic transmission system.[5] The substance called acetylcholine facilities synaptic transmission, while certain hormones, including adrenalin and the recently discovered brain hormone, *serotonin,* have an inhibitory effect. Alcohol and certain drugs apparently affect behavior by blocking or facilitating synaptic transmission.

Sensory Feedback. Our discussion of some of the specific mechanisms underlying behavior should not obscure the fact that behavior is a complex and continuous process, and that specific reflexes rarely occur independently in the behaving organism. Patterns of movements which we arbitrarily break up for study are actually tied together to give continuity and coordination in the general course of behavior.

A significant factor in the coordination of specific movements in sustained activity is the sensory feedback from responding effector organs, or sensory messages giving information about a response as it occurs. Sensory feedback is involved in all coordinated sequences of movements, such as those used in walking and in maintaining posture. The diagram in Figure 4.27 shows in a simplified way how two (or more) sensory sources interact to control sustained motion. The primary sensory input, which might be visual stimuli used to guide the movements of walking, acts to release and direct a course of action, while the sensory feedback, initiated by movements thus released, is a means of correcting, redirecting, and pacing the movements. The sensory feedback from the muscles used in walking, for example, might indicate that the step was displaced because of some obstacle or depression in the walk. The principle of feedback is extremely important in the organization of behavior, and we shall meet it in different contexts throughout the book.

The Nature of the Response Mechanism. We have been talking about the organization of behavior in the response mechanism—that is, the bodily systems of activity. We have seen that there are two general characteristics of behavior which can be related to the regulatory systems of the

body. First, behavior is marked by relatively slow, persistent variations in the level of activity which are correlated with the chemical states of the body, affecting behavior through neurohumoral action. Second, much of our behavior is characterized by fast, highly articulated, detailed perceptions and specific motor responses that are organized in relation to the stimulating patterns of the external environment. These refined patterns of response are made possible by the ability of the receptors, central nervous system, and effectors to differentiate many variations in stimulus patterns and translate these discriminations into skilled movements.

As we continue our study of behavior, we shall be concerned with now one aspect and now another of organized behavior. In studying motivation and emotion, we shall be emphasizing mainly the persisting, driving nature of behavior related to neurochemical states. In our study of conflict and frustration, we have already seen how forceful and long-lasting these motivational-emotional states can often be. When we study perception and different aspects of skilled movements, we shall be primarily concerned with the individual's ability to make detailed discriminations and finely articulated patterns of response. Behavior as a whole, however, is neither one nor the other of these characteristics, but represents their combined effects. Motivated behavior is always organized in terms of the external environment, and specific responses are never independent of the ongoing motivational state. Even the most specific reflexes occur within the frame of reference of the general state of activity—a knee jerk may not appear during sleep, and the salivary reflex can be inhibited by strong emotion.

The response mechanism undergoes many changes during the course of individual adjustment. It is through such change that behavior and the bodily processes of behavior are modified and individualized. As the child grows and learns, he evolves a psychological and physiological make-up which are one and the same, incapable of being separated. Human behavior is the body in action as an integrated system.

Our next concern is to understand how some of the changes come about in adjustment, how the individual gradually develops, and how his behavior is organized and reorganized through motivation, emotion, perception, learning, and thought. As we study these different aspects of behavior, we shall try to understand how each of them is integrated into the overall adjustive activity of the behaving system.

SUMMARY

We study the relationships between behavior and body processes to gain greater insight into the organization of response. In order to understand overt, observable behavior, we need to understand the action systems of the body.

There are many shifts in the general level of activity correlated with motivational and emotional patterns of behavior. Both the level and direction of activity are determined by bodily processes and external conditions acting together.

The regulatory mechanisms of the body are the nervous system and the system of endocrine glands, which interact to effect a neurohumoral integration of activity. The hypothalamus of the brain is an area where nervous and chemical processes affect each other. The special features of the chemical

regulators are in their general, gradual, and long-lasting effects on behavior.

The level of activity of the individual is related to the activation pattern of the brain. A high level of activity in the brain is maintained by neural impulses from the afferent nerve pathways and the lower brain centers which are sensitive to hormonal concentrations. When the activation level in the brain is reduced, bodily activity is also reduced.

Stimuli are forms of physical energy to which the receptors of the body are sensitive. A receptor system always responds in terms of its own special properties, irrespective of the properties of the stimulus. The kind of stimuli for which a receptor has the lowest threshold are the adequate stimuli for that receptor.

Differential reactions to the distribution of stimuli in the environment are the basis of perceptions of space and objects and of the individual's capacity to adjust his movements to these perceptual patterns.

The nervous system makes possible rapid and highly differentiated response patterns. The cerebellum is a center which regulates the timing of body movements, while the cerebral cortex regulates the organization of behavior in space. All of the major sensory and motor systems of the body have specific representation in the cortex.

Reflexes are restricted forms of movement or glandular response, consistently related to specific forms of stimuli. The simplest reflex would involve a receptor, a sensory neuron, an association neuron in the central nervous system, a motor neuron, and an effector.

The reaction time of an individual to a stimulus varies with the kind of stimulus and the kind of response required. Discrimination and association times are longer than simple reaction times.

The three types of receptors are exteroceptors, proprioceptors, and interoceptors. Effectors include muscles and glands. Both muscle and nerve fibers react according to the all-or-none law, which states that each fiber reacts to its maximum extent or not at all.

Synapses are the gaps between adjacent nerve cells at which inhibition or facilitation of nerve impulses can occur. Learning and fatigue probably involve chemical changes in aggregations of synaptic connections.

Sensory feedback provides information about behavior as it is occurring to help time, correct, and integrate successive movements.

PART 2. THE DIMENSIONS OF BEHAVIOR

Our survey of the organization of behavior and of the behaving organism in Part 1 has revealed some of the fundamental characteristics of human—or animal—conduct. Any pattern of responses is organized with respect to several kinds of determining factors. In the first place, behavior is organized by the periodic, persisting internal states that we know as motivation and emotion. Secondly, it is organized in relation to the external environment, as the patterns of that environment are perceived and reproduced in skilled movement. In the third place, behavior is defined by the structure and mode of action of the movement system itself—the human body. Finally, behavior is organized in time; it develops and changes continually as the organism itself develops and changes.

In Part 2 we shall be concerned with a more detailed analysis of these dimensions of behavior—motivation-emotion, perception, skilled movement, and development. Our first concern will be to understand the general course of development throughout life, in particular the formative early years. We shall then turn to the dynamic characteristics of behavior as manifested in motivation and emotion, from the specific physiological states to the very general motives that drive the individual to action. To understand perception, we shall need to describe the different receptor systems of the body and how they work together to give us our knowledge of the world; then back again to the temporal dimension of change—how the individual learns and also how he learns by thinking. Finally we shall devote a chapter to the most fascinating of all the forms of human behavior: verbal behavior and communication.

As we analyze the different dimensions of behavior we must not lose sight of the fact that they do not exist alone, but are complementary aspects of the overall adjustment of the individual to his environment.

CHAPTER 5. THE DEVELOPMENT OF BEHAVIOR

Human behavior is a continuous process from its first beginnings in the unborn child until death. The continuity, however, is marked by many changes in the individual and in his environment. The first major environmental change occurs at birth, when the infant leaves the watery environment of the uterus for the world of light and air. The individual personality begins to differentiate early in infancy, a remarkable period when growth and development proceed at an almost unbelievable rate. In childhood and adolescence we see the blossoming of motor skill, emotions, social conduct, and intellectual achievement, leading to the peak energies, abilities, and sexual power of early adulthood. Although the individual never stops learning, old age sees a general slowing down of response as well as the decline of sensory acuity, alertness, and motivation.

THE COURSE OF DEVELOPMENT

The task of genetic or developmental psychology is to understand how the periods of development influence the course of adjustment. This task involves understanding how one period of life affects a later one—how prenatal development influences infancy, or how infancy helps determine the course of childhood and later life. More specifically, we are going to try to understand the developmental processes and the factors that determine their course.

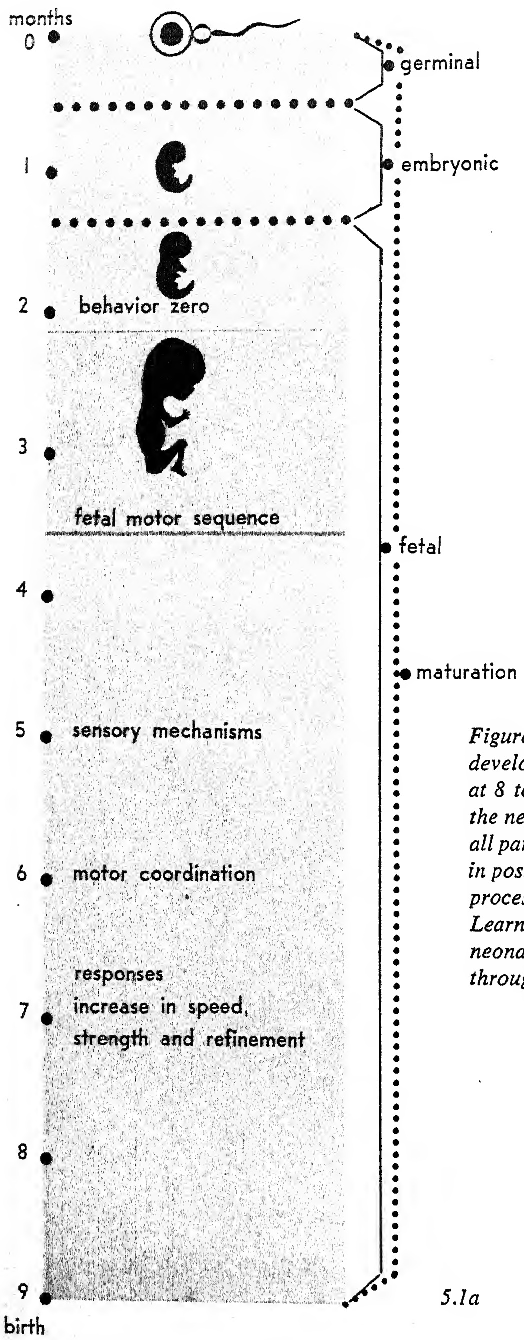


Figure 5.1. a. *Stages in prenatal development. The first behavior occurs at 8 to 8.5 weeks fetal age. During the next six weeks, reflex movements of all parts of the body mature.* b. *Stages in postnatal development. Maturational processes taper off after adolescence. Learning usually begins after the neonatal period, and goes on throughout life.*

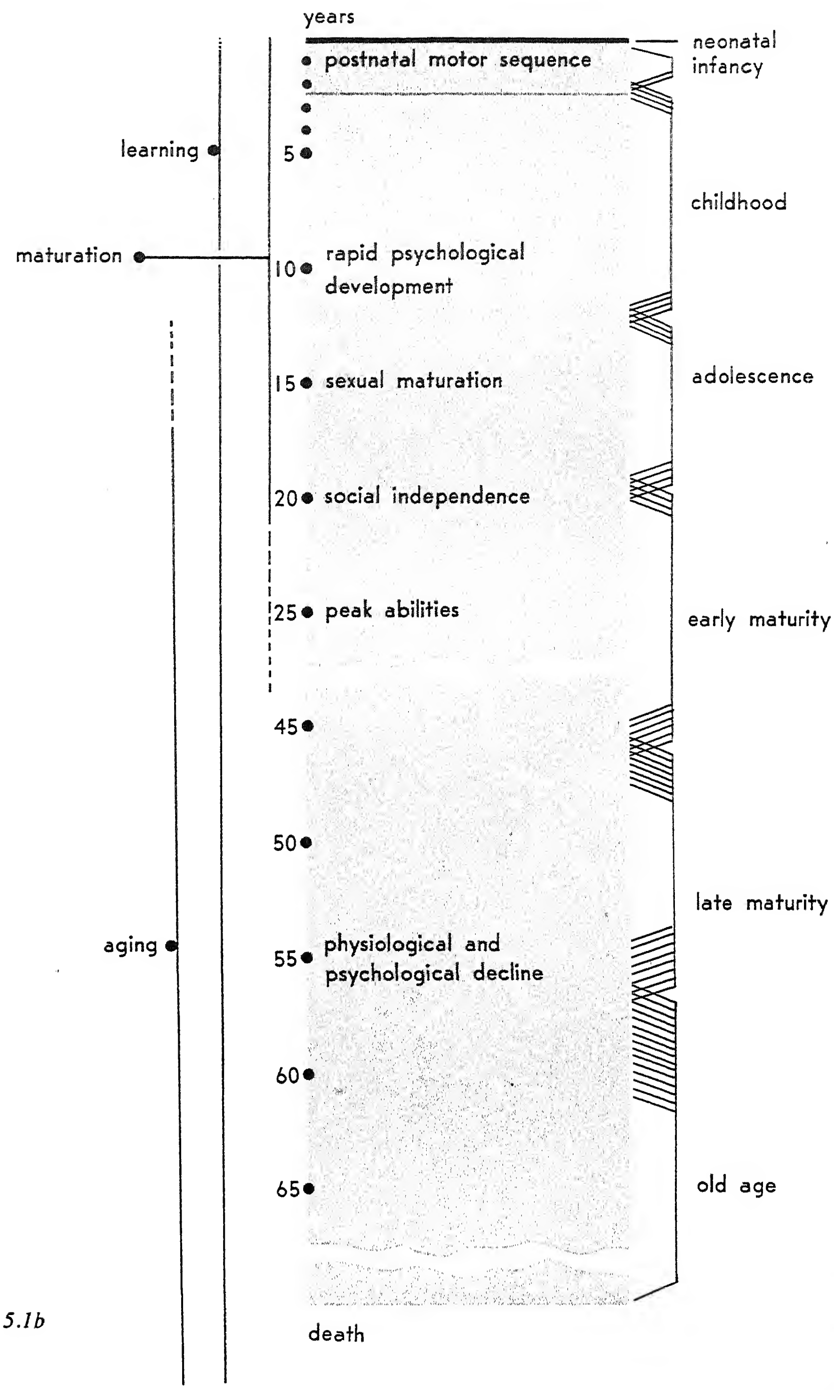
Growth and Development. The changes that occur in the individual throughout life can be described as growth and development. By growth we mean increase in size, the enlargement of structure, or the adding on of cells. Development, on the other hand, refers to the elaboration and refinement of the living system. As a child develops there are progressive changes in his body organs and physiological processes, as well as related changes in his behavior. When we observe developing behavior patterns, we infer that there are corresponding changes within the body, whether or not we can identify these changes exactly. Thus we believe that behavioral development depends on underlying processes of physical development. It is less well recognized that physical development also depends on behavioral development. Changes in anatomical and chemical relationships within the body are determined in part by behavioral change.

The psychological development of the individual involves two quite different processes: *maturation* and *learning*. By maturation we mean differentiation of function that occurs independently of behavioral experience. Learning, then, refers to differentiation which comes about as a result of experience. Just as the body of the child grows and develops independently of specific experience, so do some of his response patterns. The ability to walk depends on maturation. A child who normally would walk at thirteen months cannot be taught, by experience, to walk much younger than that. Before walking can occur, certain maturational processes have to be completed. The ability to produce vocal sounds matures, but speaking a particular language depends on specialized stimulation and learning.

It is not always possible to define sharply the roles played by maturation and learning in overall development. A baby begins to walk only when he is maturationally ready; but once the first steps have been taken, an element of experience has been introduced into the situation. Thus his individual patterns of walking are determined in part by learning. In the same way, almost all behavior that develops through maturation is subject to modification by learning.

Heredity and Environment. There are two sets of factors that determine the course of growth and development. They are heredity and environment. An individual starts out as a fertilized egg with a precise genetic organization which influences his development throughout life. But from the moment of conception, he exists in an environment which supports and sustains him as well as influences the course of maturation and learning. All kinds of behavior are thus the result of both hereditary and environmental factors. One of our tasks in this chapter is to assess the *differential* roles played by heredity and environment in development—that is, to identify variations in behavior that can be related to variations in one or the other set of determining factors.

Developmental Periods in Human Life. The course of life is marked by a number of developmental periods, indicated in Figure 5.1. The only sharp transition between one period and another is the event of birth, at which time the infant must make a sudden adjustment from prenatal to postnatal life. The short nine months span of prenatal life is shown in Figure 5.1*a*, the course of postnatal life in Figure 5.1*b*.



5.1b

The course of prenatal development can be thought of as encompassing three periods: the germinal, embryonic, and fetal periods. True behavior first occurs in the fetus at an age of about eight weeks, when the first body movements occur. We call this point, behavior zero. Between the time of the first movement and the age of fourteen or fifteen weeks, the human fetus develops through maturation almost all of the primary forms of reflex movement of different parts of the body. This period of maturation, as shown in Figure 5.1*a*, we shall call the *fetal motor sequence*. During the remaining five and one-half months of the fetal period, other maturational changes take place: sensory mechanisms develop; movements are refined, integrated, speeded up, and become more powerful; coordinated reflex movements evolve as various parts of the nervous system develop and are activated. As we shall see, it also may be possible for the late fetus to develop by learning.

Postnatal development can be divided into six main stages as shown in Figure 5.1*b*: neonatal (or newborn), infancy, childhood, adolescence, maturity, and senescence. These stages are well recognized, but are not set off sharply from one another. The first month of life following a full-term birth is called the neonatal period. Infancy lasts until the second year, and is followed by childhood. Puberty, the age of onset of sexual maturity, marks the beginning of adolescence. This period usually starts at twelve to thirteen years of age in girls and about two years later in boys. Adulthood is thought of as starting at about the twentieth year, or when the individual becomes psychologically mature.

It is generally believed that development of behavior in the fetus is entirely a matter of maturation. The elaboration of behavior during the neonatal period is also maturational, showing little if any modification by learning. From that time on until early adulthood, maturation and learning interact closely in the evolution of patterns of behavior. The processes of physical growth and maturation slow down in the twenties, but psychological development goes on by means of learning, thinking, and forgetting, within the limits set by processes of aging. As the individual passes the period of peak capacities, the aging processes accelerate, and some deterioration takes place in almost all aspects of psychological activity. Among the various activities developed earlier in life, verbal ability, the use of language, and refined manual skills persist with least deterioration into old age.

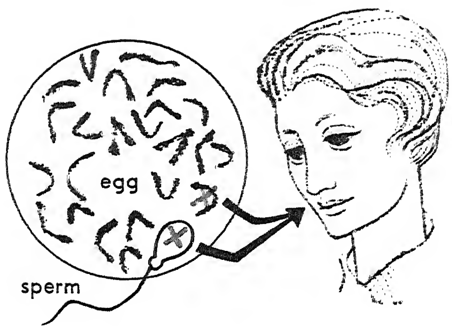
THE FACTOR OF HEREDITY

The individual characteristics that distinguish the newborn infant are very largely due to hereditary factors. Within the relatively stable uterine environment, prenatal maturation expresses a genetic make-up passed on from the mother and father to the offspring. However, the effects of heredity do not end at birth, but occur throughout life. Even the processes of aging are in part a manifestation of intrinsic hereditary factors carried in each cell of the body. The whole timing and pattern of maturational development is circumscribed by the mechanisms of heredity.

Chromosomes and Genes. How are characteristics of one generation carried to the next? The answer lies in the *chromosomes* and *genes* of the germ cell. Each individual develops from the union of a microscopic male sperm cell containing 24 chromo-

somes, and a much larger egg cell also containing 24 chromosomes. Every chromosome is composed of hundreds of still smaller particles—the genes, the ultimate factors of heredity. Each of these genes has some role, either alone or in combination with others, in defining the course of development. Some of the difficulty in understanding the role of heredity in behavior is due to the fact that genes rarely act alone but produce their effects in complex combinations.

An example of how genetic factors influence development can be seen in the determination of sex. When an egg cell and a sperm cell combine to form a new individual, the chromosomes from each cell pair off, forming 23 pairs that are very much alike and a twenty-fourth pair which may or may not be alike. In a girl, the twenty-fourth pair contains two X chromosomes, one from the mother and one from the father. In a boy, the twenty-fourth pair contains one X from the mother and a Y chromosome, which is smaller, from the father. This process of sex determination is shown in Figure 5.2. Every sperm cell contains either an X or a Y chromosome. If an X is given to the offspring, a girl develops; if a Y is given, a boy develops. Thus the sex of the child is determined by the sperm, not the egg.



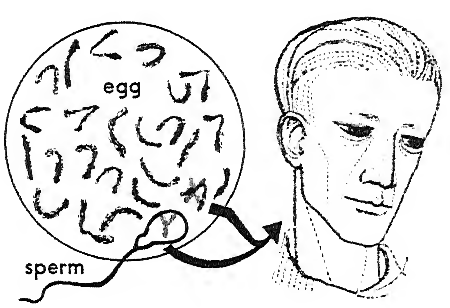


Figure 5.2. The genetic determination of sex. The sex of an individual is determined by one pair of chromosomes. An egg cell always contains an X chromosome, while a sperm cell can contain either an X or a Y. An XX combination produces a girl; an XY combination produces a boy.

Dominant and Recessive Traits. Although the pairs of chromosomes are superficially similar (except for the XY pair in males), differences can exist among the thousands of pairs of genes. When two genes of a pair are not identical, one is apt to be dominant over the other. The *dominant* gene influences development, while the *recessive* gene, though it still exists in every cell and can be passed on to the next generation, cannot exert its influence in this particular individual.

Dominance and recessiveness can be demonstrated in a number of well-defined characteristics. Eye color is one example. The general rule for the genetic transmission of eye color is that genes for the darker shades are dominant over the lighter shades. The "blue-eye" gene is recessive to all other colors. A brown-eyed person may carry two brown-eye genes, or just one for brown eyes and a hidden or recessive gene for lighter eye color. On the other hand, a blue-eyed person can carry nothing but two blue-eye genes, which he passes on to all his offspring. A recessive gene cannot exert its particular influence unless paired with another recessive gene of the same kind.

The differences that exist between the X and Y chromosomes in the male make

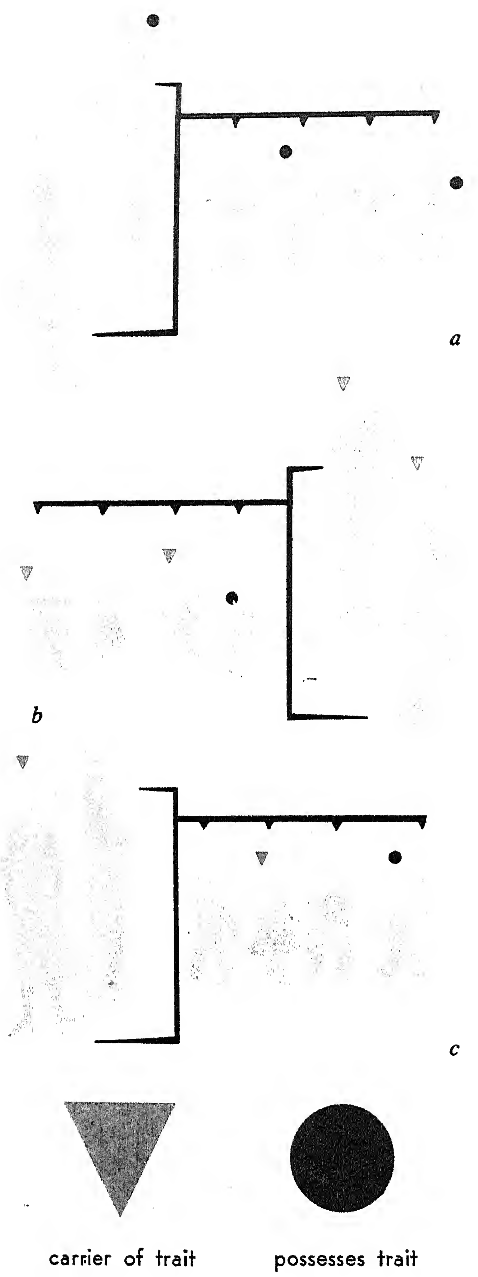


Figure 5.3. The genetic transmission of traits. a. *When one parent has a trait determined by one dominant gene, half his children are likely to receive it.* b. *When both parents carry the same recessive gene, half their children are likely to carry it and one-fourth are likely to possess the recessive trait.* c. *Sex-linked transmission. When the mother carries a recessive gene in an X chromosome for which the father has no dominant mate, half her daughters are likely to carry the trait recessively, while half her sons are likely to possess the trait.*

possible a special kind of transmission of recessive traits known as *sex-linked* inheritance. The Y chromosome is much smaller than the X, and does not contain genes to pair off with all of the genes carried in the X. Some recessive genes which occur in the X chromosome do not ordinarily take effect in women because of the presence of dominant genes in the other X chromosome. However, when a mother passes on to her son a recessive X gene for which there is no dominant mate in the Y chromosome, then the recessive trait can appear in the son. Hemophilia, the "bleeding disease," is a sex-linked characteristic.

There are a number of behavioral characteristics that have been traced to their determining conditions in dominant or recessive genes.[1] Two dominant traits, which fortunately are quite rare, are transmitted as shown in Figure 5.3*a*. Huntington's chorea is a progressive mental and physical deterioration, with quite a sudden onset in adulthood, which leads to death in a few years. Retinoblastoma is a malignant cancer that begins in the retina and spreads to the brain. In each case a single dominant gene causes these conditions. The transmission of ordinary recessive traits is shown in Figure 5.3*b*. An example of such a trait is a so-called taste blindness, or the inability to taste certain substances. Another recessive trait is amaurotic idiocy, a disease in which mental degeneration, paralysis, and blindness lead to an early death. A sex-linked recessive trait which occurs in about 4 percent of all males is a form of color blindness—the inability to distinguish between red and green (Fig. 5.3*c*).

Psychological characteristics which are regulated by primary genetic mechanisms, such as those shown in Figure 5.3, represent only a very limited part of human

behavior. We do not know how genetic factors express themselves in such characteristics as intelligence, motor skills, creativity, artistic ability, and so on. Some of these abilities "run in families," but do not fit into any simple pattern of dominance or recessiveness. Complex behavior patterns are influenced by so many environmental variables that the hereditary influences are often obscured.

Genetic Mutation. We have been speaking of the genes as the fixed hereditary factors in development. It is true that they are relatively fixed. Behavior leaves no record in the genes, nor do ordinary environmental conditions affect gene structure. Yet we know that all the evolutionary changes since life began have come about through changes in the genes. We call such changes *mutations*.

Mutations are changes in the chemical structure of the genes which can be produced by various types of radiation, including x-rays, cosmic rays, and the radiation from atomic bombs. When a mutation does occur, the changed structure is passed on to offspring. If it results in a characteristic that affects the capacity of the individual to live successfully or to reproduce, the family line may cease and the changed characteristic be lost. Geneticists believe that mutations occur rather frequently. It has been theorized that the hemophilia which has plagued the royal families of Europe during the past century arose in Queen Victoria through mutation.

Hereditary Likenesses and Differences in Families. One of the most obvious and interesting things about children of the same family is that they differ. They differ perhaps within a certain framework of family resemblance, but each has his own distinctive appearance and personality. The genetic basis for family differences is easy to understand. Although each child of the same parents receives half his chromosomes from each parent, the different combinations of these chromosomes are almost limitless. When we realize that the possible number of combinations of genetic factors from each parent runs into many millions, we understand how remote is the possibility that any two fertilized eggs, even from the same parents, will ever have exactly the same genetic make-up.

Yet it is a fundamental fact that members of the same family are typically more alike than members of a community chosen at random. Family similarities are undoubtedly due in part to similar environments as well as to common hereditary factors. Some of our most valuable information on the differential roles played by heredity and environment comes from studies of twins and other types of multiple births.

There are two different kinds of twins. Fraternal twins, who may be of the same or different sex, develop from two different eggs fertilized at approximately the same time. Genetically, fraternal twins are no more alike than other brothers and sisters of the same family. Fraternal twins, especially fraternal twins of the same sex, often seem, in general, more similar than other pairs of brothers and sisters. This closer similarity must be attributed to the fact that they have had very similar environments. Identical twins, on the other hand, have identical genetic make-up, since they are derived from a single fertilized egg. Obviously they always must be of the same sex. Sometimes the similarity between identical twins may be so great as to

Figure 5.4. Identical twins have identical genetic make-up. Any structural or behavioral differences that appear in them are due to environmental influences. Fraternal twins are no more alike genetically than ordinary siblings, but usually resemble each other more closely because of their similar environments.

confuse even members of their own family (Fig. 5.4).

Identical twins, even with their identical genetic origin, develop many differences that must be attributed to environmental influences. Even before birth, one twin might have a slight advantage over the other in terms of position or nutrition. Differences in their environment are most significant, however, if for one reason or another they are separated early in life and reared apart. In cases like this, identical twins sometimes exhibit quite noticeable differences in general psychological development, although for the most part they are still strikingly similar.

Evolution of Behavior. There is only one species of man presently existing on the face of the earth, *Homo sapiens sapiens.* In the course of the half-million-odd years since he emerged as a well-defined species, man has changed, but only in superficial ways. Variations in body build, skin color, and so forth differentiate the various races of man, but their general similarities reflect the basic identity of human genetic factors. The fundamental differences between man and other species of animals are related to genetic differences.

A basic principle of biology is that there is a continuity between the germ plasm of animal forms, including man. The evolutionary line which produced the human animal is not entirely clear, since some of the intervening subhuman forms no longer exist. However, we can trace general evolutionary changes, both in body structure and behavior, among animal forms that have survived.

Evolution can be explained in terms of two primary biological mechanisms: mutation and natural selection. We have already learned that mutation is a chemical change in the genes resulting in the appearance of new or changed traits in body form and/or behavior. Through such genetic change, occurring over the millennia of time, animal life has gradually evolved ever more complex forms capable of performing increasingly complex adjustments to their environment. The principle of natural selection is used to explain, not how genetic changes occurred in the first place, but which changes in structure and behavior shall survive. Many animal forms besides man have changed very little for long periods of time. Some animals, like the ants, have adjusted successfully to their environment for millions of years.

Some of the principal stages of animal evolution are shown in Figure 5.5. The earliest forms of behavior, such as movement away from or toward a stimulus, are found in single-celled animals. A major aspect of the evolution of invertebrate animals—jellyfish, spiny sea animals, worms, insects, and mollusks—is the development of the centralized nervous system. With this change in body structure come coordinated

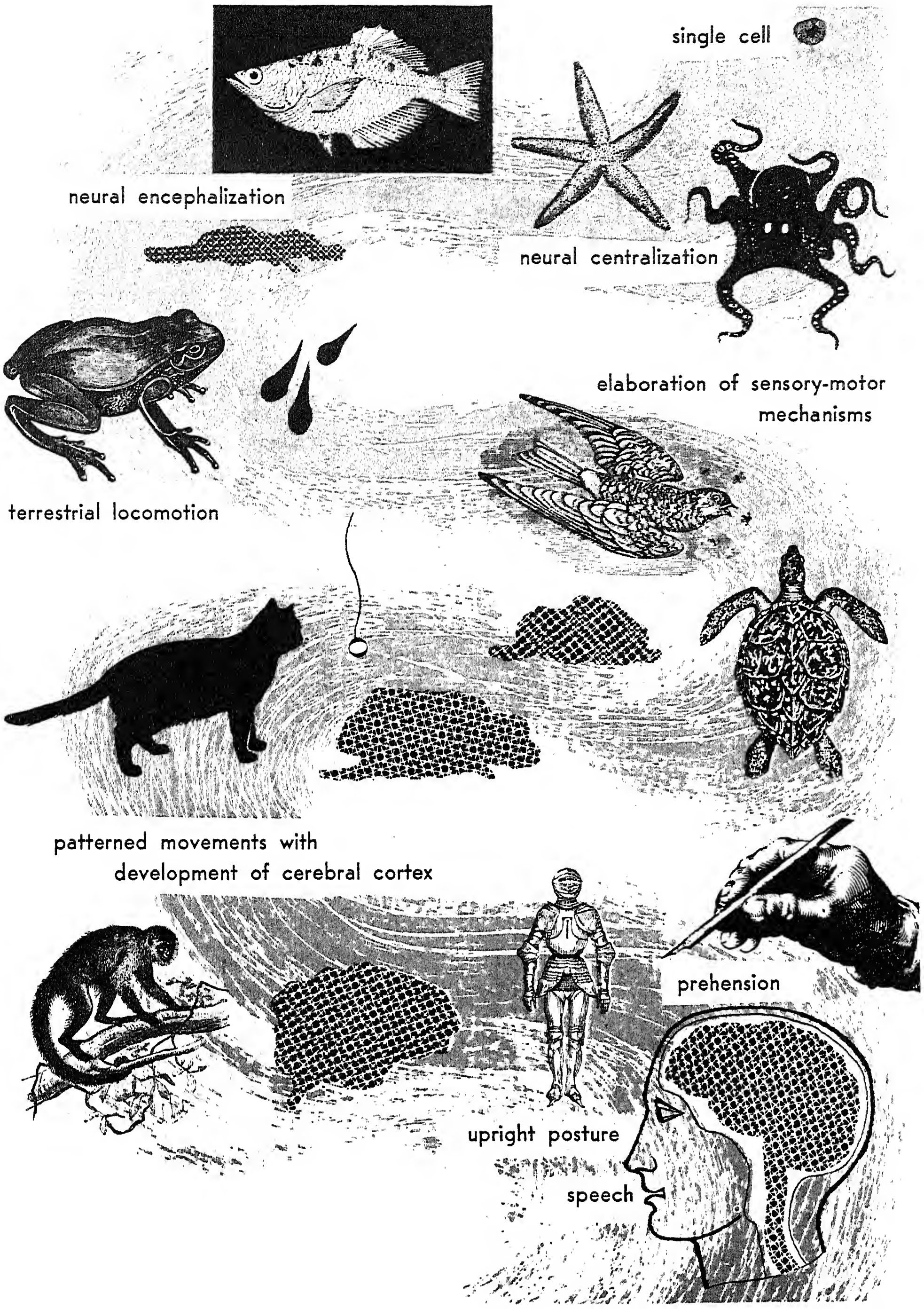
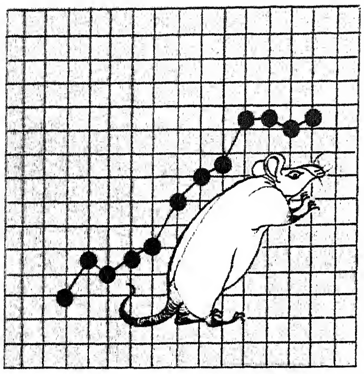
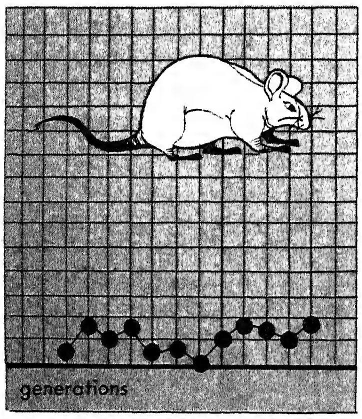


Figure 5.5. Evolution of behavior in the animal series. Increasingly complex behavior from the lower animal forms to man parallels increasingly complex bodily forms. The nervous system becomes centralized and then concentrated more and more in the head region. In behavior we observe greater and greater adaptability to the environment, elaboration of sensorimotor mechanisms, and increased socialization and cooperation.



a



b

Figure 5.6. Hereditary emotionality in rats. The graphs show measures of emotionality in twelve successive generations of rats bred for excitability, a, *and docility,* b. [From Hall, C. S. The genetics of behavior. In Stevens, S. S. (Ed.) *Handbook of experimental psychology.* New York: Wiley, 1951. Pp. 304–329.]

reflex behavior, the ability to learn, and more complex forms of response—exemplified by the activities of the social insects, such as ants or bees. A forebrain in the head region makes its appearance in the most primitive vertebrate forms—the fishes and fishlike animals. As indicated in Figure 5.5, the gradual concentration of the neural mechanisms of control in the forebrain is described by the term *encephalization.*

The evolution of behavior in amphibians, reptiles, and birds is marked by the development of specialized sensory and motor mechanisms, including terrestrial locomotion, the refinement of vision and hearing, and the adaptation of the limbs for flying, fighting, and other special activities. In mammals there is another major advance in encephalization—the development of the cerebral cortex. Related behavioral effects are seen in the elaboration of patterned movements in using and manipulating objects in space. This trend is characteristic of most mammalian forms, such as the rat, cat, and monkey shown in the figure.

The distinctive features of the evolutionary development of man are true prehension, upright posture, speech, and sociocultural behavior. Along with these noteworthy human characteristics are great flexibility in adapting to the environment, an almost endless capacity to learn, the ability to think and reason, and great skill in the use and fabrication of tools and machines. The behavioral characteristics that mean so much to modern man and society are without doubt the same characteristics used many thousands of years ago by primitive peoples to adapt to different environments. It is not only man's body form and specialized reflexes that are a product of evolution. So also are the definitive aspects of human behavior relating to creativity, socialization, intelligence, and skill. Man inherits from his past the basic patterns of conduct that make him human.

THE DETERMINANTS OF DEVELOPMENT

There are two sets of factors which determine the course of development: heredity and environment. There are also two distinct kinds of developmental process: maturation and learning. In general, we think of maturation as an expression of hereditary factors within an adequate, or normal, environment, for inadequate or unusual environmental conditions can change the course of maturation. We also think of learning as primarily an expression of environmental factors, although hereditary factors set limits on the nature and complexity of learned behavior.

Analyzing the course of development is a matter of understanding the differential roles played by heredity and environment in all kinds of behavior, both maturational and learned. We are going to describe here some representative studies which bear on these problems.

Genetic Studies. In lower animals it is possible to carry out breeding experiments to study the operation of genetic factors in development. The advantages of using animals in this type of study are twofold. Aside from the obvious advantage of being able to control matings, there is the added advantage of the short life span of many animals. It is possible to study many generations of laboratory rats within a reasonable period of time.

Casual observations on different breeds of dogs, chickens, sheep, and so on, indi-

cate that there are basic differences in emotionality, or excitability, that run in family lines. Laboratory albino rats are much more docile and less excitable than gray rats, yet even among the albinos there are observable differences. When pairs of the most excitable and least excitable albino rats in a colony were bred selectively for a number of generations, a line of emotional or excitable rats was produced, and another line of docile animals. Measures of emotionality in twelve successive generations of excitable and docile rats are shown in Figure 5.6. Other breeding studies have confirmed that emotional and motivational characteristics can be bred into white rats. In some cases these characteristics affect the animal's ability to learn in specific situations.

There have been many attempts to trace various personality traits in human families. Superior abilities—musical, artistic, or intellectual—often persist in family lines to such an extent that we feel sure that they are due in part to inheritance. On the other hand, such abilities undoubtedly need a favorable combination of training, social experience, and other environmental conditions for their fullest development.

Studies of Twins. The relatively few situations where identical twins have been separated early in life and reared apart provide the psychologist with readymade conditions in which to study the differential effects of environment on development. Since identical twins have common hereditary factors, any differences that arise between them must be attributed to the effects of different environmental conditions on maturation and learning.

Nineteen pairs of identical twins reared apart were studied extensively to determine whether the development of intelligence and other personality traits could be related to differences in educational and cultural opportunities.[2] The results of this twin study are open to differences in interpretation, but some of the observations seem clear. For twelve pairs, there was very little difference in the educational environments in which the separated twins lived. These twins showed few differences in ability and personality. For an additional five pairs, there were marked differences in environment during development. These pairs displayed sharp differences in ability. One pair showed little difference in ability in spite of great differences in educational opportunity. The last pair, for whom the educational environments were similar but other cultural advantages differed greatly, showed marked differences in ability.

Overall, these nineteen pairs of twins resembled each other less closely than identical twins reared together, but more closely than random pairs of brothers and sisters reared together. However, the significant thing about the results is that in six pairs there were sharp differences in mental ability, attributed to different environmental conditions during development. Genetic factors set limits to developmental abilities, but in order for these potential abilities to be realized, certain minimal environmental conditions must be met.

Restriction of Stimulation. Another experimental approach to the study of development is to determine whether or not a given behavior pattern is maturational. This is done by restricting the environment in such a way that practice or learning effects are eliminated. Several studies indicate that patterns of locomotion are typically maturational, whether they involve

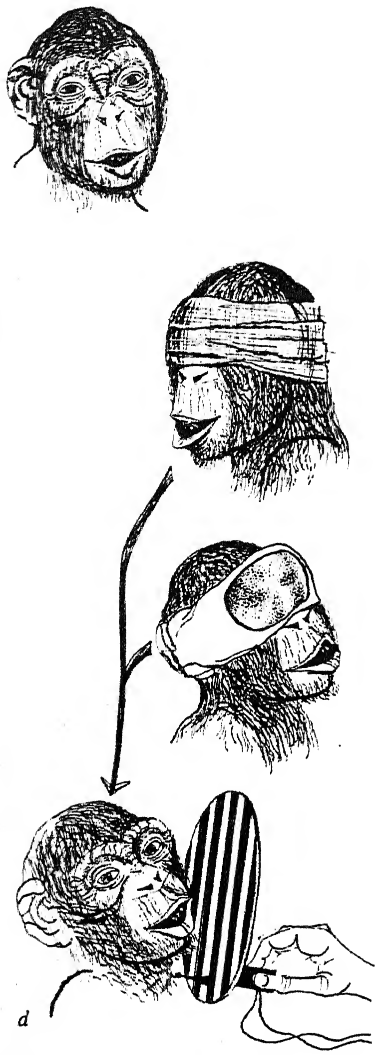


Figure 5.7. Effects of visual deprivation in infant chimpanzees. Animals allowed even limited periods of normal vision in infancy developed normally, a, *but those completely deprived of visual stimulation,* b, *or allowed periods of diffuse light stimulation,* c, *were markedly retarded in visual perception,* d. [Based on Riesen, A. H. Arrested vision. *Sci. Amer.*, 1950, **183** (1), 16–19.]

swimming, flying, or walking. In an early study, a number of larval salamanders were placed in a drugged solution which anesthetized them but did not retard growth.[3] At an age when normal salamanders were swimming well, these drugged salamanders were placed in fresh water and were soon swimming freely, after an interval just long enough for the effects of the drug to wear off. Baby birds raised in restrictive halters until the age when flight normally occurs were able to fly immediately on their release.[4] When the restriction was continued too long, however, the birds did not fly when they were released. The fact that walking occurs in many mammals almost from the moment of birth indicates that it, too, is due to maturation.

Although we do not experiment with human babies by restricting their movements, many primitive peoples bundle their babies for some time after birth. Hopi Indian children traditionally have been bound on a cradle board for months, with but short periods of freedom in which normal movements can take place.[5] This severe restriction of movement and stimulation during the early months apparently does not retard the development of walking. Hopi children who are bound in the traditional manner learn to walk at the same average age as other Hopi children who are given freedom of movement.

Perceptual retardation due to restricted stimulation. Although the complex patterns of locomotion apparently can mature normally even when practice is eliminated, other observations lead us to believe that grave psychological effects sometimes occur as a result of undue restriction of environmental stimulation. For example, a study of infant chimpanzees has shown that development of visual perception is arrested as a result of depriving the young animals of either light stimulation or form stimulation (Fig. 5.7).

The procedure in this experiment was to take newborn chimpanzees from their mothers and keep them in a completely dark room. When removed from this room for any reason, they were blindfolded. Two animals, Snark and Alfalfa, were visually isolated in this manner for sixteen months, during which time their only light stimulation was from an electric lamp turned on for forty-five seconds several times a day. Debi was raised for seven months in complete darkness (Fig. 5.7*b*). Kora and Lad were kept in a dark room for seven months but allowed a limited amount of visual experience. Kora wore translucent goggles for an hour and a half daily (Fig. 5.7*c*), which permitted diffuse light stimulation, but not perception of form. Lad was permitted normal vision for an hour and a half each day (Fig. 5.7*a*), during feeding and other care.

When the isolated animals were first put in lighted quarters, their reactions showed that prolonged visual restriction had resulted in marked retardation in visually controlled behavior. Lad, who had been allowed ordinary vision for an hour and a half daily, behaved in a completely normal fashion, but the others responded very poorly to visual stimulation. Although their eyes were still sensitive to light, they could not utilize vision to coordinate their activities in relation to the environment. They did not respond to objects moving toward them until actually touched by the objects. It took hundreds of hours to develop visual perception to the point where ordinary locomotion and manipulative movements were visually controlled. It is significant that Kora responded in about

as inefficient a manner as the other animals, even though she had received diffuse stimulation through the plastic goggles for an hour and a half daily. On the other hand, a daily period of ordinary patterned visual stimulation permitted Lad to develop normally.

One of the tests of pattern vision was a large yellow and black striped disk wired to give an electric shock when the animal touched it (Fig. 5.7*d*). Normal chimpanzees learned to avoid it after receiving one or two shocks, but Debi and Kora, after seven months in the dark, received shocks from the disk twice a day for some two weeks before they would avoid it when presented visually. Visual acuity, depth perception, and form perception of common objects such as the feeding bottle were all greatly retarded.

The young chimpanzees kept longest in the dark displayed some physiological deficiencies of the retina. When they were given an ocular examination, it was found that the optic disk (the point of emergence of the optic nerve) showed a loss of normal color. Apparently, some light stimulation is needed for the completely normal development of the eye.

These effects of visual isolation are paralleled by some of the phenomena of human visual perception and behavior following removal of optic cataracts (opaque growths on the eyeball).[6] When congenital cataracts—that is, cataracts which have been present since birth—are removed at an age beyond early childhood, gross deficiencies in visual perception are observed. Normal perception and identification of common objects may come only after months or even years. The chimpanzee studies indicate that defects in the eyes resulting from early environmental restriction may account for some of the retardation, and that this same environmental restriction leaves its mark on behavioral development as well.

Emotional-social retardation in a restricted environment. The experiments with the chimpanzees revealed serious retardation in a relatively limited kind of perceptual development as a result of environmental restriction. In another important series of experiments, young puppies were raised in a severely restricted environment to determine whether their general psychological development would be affected. As shown in Figure 5.8*a*, the restricted animals were raised in closed cages from which they could not see out, although light was admitted from the top. Littermates of these puppies, to be used as controls, were raised as pets. Thus one group of puppies had a

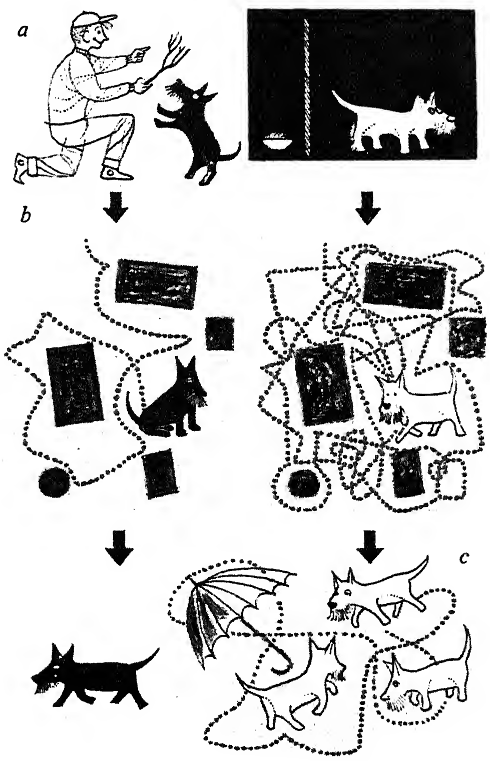


Figure 5.8. Effects of early restriction of behavior. Pups raised in a normal and in a restricted environment, a, *were later tested in many types of behavior. In a strange situation the restricted pups explored far more than the normal pups,* b, *and they also became much more excited at strange objects,* c. [Based on Clarke, R. S., *et al.* Individual differences in dogs: preliminary report on the effects of early experience. *Can. J. Psychol.*, 1951, **5**, 150–156; Thompson, W. R. and Melzack, R. Early environment. *Sci. Amer.*, 1956, **194** (1), 38–42.]

barren puppyhood, while the control group had all the rich experiences of a normal life.

After six to nine months of isolation, the restricted pups were released and handled in the same way as the controls. Many observations and many tests revealed striking differences in the behavior of the two groups. In many ways the restricted pups acted younger than their normal littermates. They displayed a lot of random activity and diffuse emotional excitement in contrast to the more subdued control puppies. When the animals were put in an unfamiliar maze, the normal puppies soon satisfied their curiosity, but the restricted pups explored actively for some time (Fig. 5.8*b*). When various strange objects were presented to the dogs, such as a live rabbit, a balloon, and an open umbrella, the normal dogs usually ran away without showing much concern, but the restricted pups became wildly excited without showing any organized behavior (Fig. 5.8*c*). The restricted animals also were much inferior in problem-solving tasks than the controls. Even after several years, the differences between the two groups persisted.

Overall, the puppies limited in perceptual experience early in life showed immaturity in emotional and motivational reactions, and consistently unintelligent behavior. These experiments indicate that the development of adaptive forms of behavior depends on a full and varied early life.

Gross environmental restriction in human infants. We have no information on human infants comparable to the experimental results on restricted animals. We recognize that some children have more limited early environments than others, but the lack of controlled conditions makes it very difficult to know what effects—if any—these differences in opportunity have on the development of adjustive behavior. Relative to this problem there have been a few cases reported of children raised in extreme conditions of isolation.

In one case an illegitimate child who had been isolated in a storage room was found at the age of five in a badly undernourished condition.[7] She could not stand, walk, or speak, and seemed to be blind and deaf. Proper diet and care immediately improved her responsiveness, although her slow progress indicated that she was definitely feeble-minded. Another child raised in isolation by a deaf-mute mother was found at the age of six and a half, and was believed to be feeble-minded.[8] This child responded well to training, learned to speak and read, and soon performed normally for her age. In cases such as these, there are not enough data available to determine whether permanent psychological damage was done by the early environmental restriction.

More bizarre are the stories sometimes reported of babies lost, abandoned, or stolen in infancy and raised by wild animals. The facts in such cases are about as easy to track down as the true life story of Romulus and Remus. Some reported cases have proved to be fraudulent, and as yet none has supplied us with any real scientific understanding of development.

Effects of Special Stimulation. The method of cotwin control, which we might have included with our studies of twins, involves the experimental study of identical twins, where one twin is given special training while the other is used as a control. Prolonged studies of one pair of identical

twins from infancy to adolescence were carried out at the Yale Clinic of Child Development.[9] Twin T was trained intensively at various times in stair climbing, block building, vocabulary, manual coordination, and memory for digits, while Twin C received no training. Twin T sometimes gained a temporary advantage due to her training, but Twin C "caught up" as soon as she reached the proper maturational level.

Another type of experiment of great popular interest is the interspecies comparison of young apes and children. In one classic study a nine-month-old boy and a seven-month-old female chimpanzee were raised for nine months in the same home as brother and sister.[10] They were given the same care and affection, were dressed alike, and trained alike in various activities. For a time the chimpanzee was clearly superior in motor development. She could walk, jump, and climb earlier, and, in general, had superior coordination. She even learned to feed herself with a spoon and was toilet-trained earlier than the boy. However, the genetic limits of ability of the ape could not be overcome by this special training in "humanization." In another study a young chimpanzee which was raised like a human baby learned to say "mama," "papa," and "cup," but there its language development came to an end.[11]

Determination of perceptual skills. A large number of experiments have been carried out to determine whether the accuracy of chicks in pecking at grain is due to maturation or learning. A recent study of this highly integrated perceptual skill indicates that it comes about as a result of maturational processes.[12] Newly hatched chicks were fitted with rubber hoods containing plastic goggles before they had had any visual experience. The control chicks wore plain plastic goggles which did not modify their visual fields, while the experimental chicks wore plastic prisms which displaced the visual field either to the left or right. The assumption is that wearing prisms should not affect the chick's ability to localize objects in space if this is a *learned* ability. The chick will thus learn to peck in a nondisplaced, accurate manner. But if pecking at objects depends on a *maturational* ability to localize the objects visually, then the displacement prisms will introduce a constant error into the chicks' performance.

This study proved quite conclusively that visual localization in chicks develops through maturation. On the first day of life the control chicks pecked at the visual object, not always accurately, but with performance centered on the object. The chicks wearing prisms showed a displaced pecking response corresponding to the angle of displacement of the prisms. The chicks wore their goggles for four days, during which time all their eating depended on their ability to obtain food by pecking. At the end of that time, all the chicks had increased their accuracy—that is, their pecks were less widely dispersed from a center—but the chicks with prisms still displaced their pecks at the same angle. Two of these chicks died on the day following this test; they had not been able to get enough food with their displaced pecking.

Many perceptual skills that develop early in the life of the human infant also depend on maturational processes. As we shall see, manual skills, such as grasping, and other skilled movements follow a fairly definite developmental pattern. However, all of the interspecies comparisons

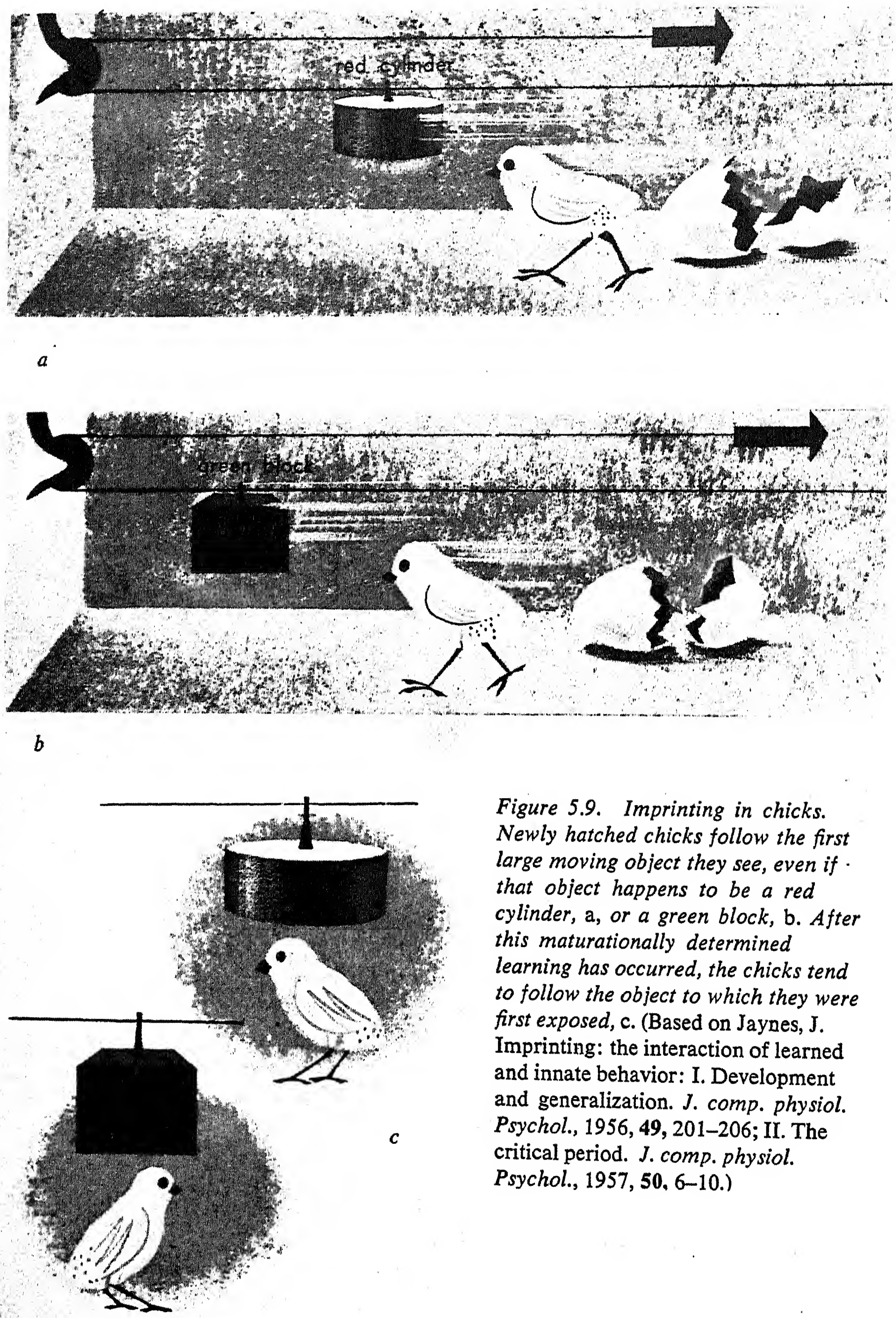


Figure 5.9. *Imprinting in chicks. Newly hatched chicks follow the first large moving object they see, even if that object happens to be a red cylinder,* a, *or a green block,* b. *After this maturationally determined learning has occurred, the chicks tend to follow the object to which they were first exposed,* c. (Based on Jaynes, J. Imprinting: the interaction of learned and innate behavior: I. Development and generalization. *J. comp. physiol. Psychol.*, 1956, **49**, 201–206; II. The critical period. *J. comp. physiol. Psychol.*, 1957, **50**, 6–10.)

of perceptual coordinations point up the greater flexibility of the human organism in adjusting to its environment. The Innsbruck studies (see page 14f.) found specifically that chickens could not adapt to inverted visual fields although the human subjects adjusted fairly successfully. Development is undoubtedly more influenced by experience or learning in the human infant than in other animals.

Imprinting. A dramatic example of early behavioral development is a type of rapid learning in birds known as *imprinting.* Chicks, goslings, and certain other ground-nesting birds tend to follow the first moving object they see after hatching. If a person who cares for the young birds is the first large moving object they see, they adopt him as a "mother" and follow him about constantly. This behavior is apparently a maturational pattern depending for its elicitation on adequate environmental conditions. It can occur only during a short time in the early life of the bird; i.e., there is a *critical period* for this integrated maturational-learning development to take place.

In a controlled laboratory study of imprinting, chicks on their first day of life were placed one at a time in a large alley containing a stimulus object which could be moved up and down the alley intermittently (Fig. 5.9). Some chicks were presented with a red cardboard cylinder, while others saw a green block. Within a few minutes, the chicks were approaching and following the stimulus object. After four days of training, the chicks were tested to see if they preferred the object to which they had been trained. When they were released in the presence of both stimulus objects, all of the chicks trained to the green block gathered around it, and all of those

trained to the red cylinder gathered there.

Further experiments showed that imprinting in this particular situation was possible only during the first few days of a chick's life. The best results were obtained during the first two days; that is, during a relatively short critical period, the chicks were susceptible to a type of learning, or behavioral development, which could not be elicited at a later time.

Studies of imprinting in ducklings have shown that this rapid learning is almost impossible when the birds are given a drug that reduces emotionality and relaxes the muscles.[13] It seems that imprinting, like other learning (as we shall see in Chap. 10), depends on the animal's activity.

Maturation and Learning. What conclusions can we draw from these studies of maturation and learning? It seems clear that genetic factors, *operating in an adequate environment,* set a time schedule for maturational development. Individuals of the same species mature roughly at the same rate, showing in general the same pattern of behavioral development. A critical aspect of maturation is the necessity for an adequate environment. Although we cannot define all of the conditions of adequacy, we know that physiological deficiencies due to malnutrition, disease, or other factors can affect normal growth and development. Further, the experiments on environmental restriction show that abnormal psychological conditions can seriously retard, even permanently interfere with, the processes of maturation.

There seems to be an optimal time at which certain behavior patterns should appear, either as a result of maturation, or of maturation plus learning. Thus, birds wearing restrictive halters past the time of normal flight were actually retarded in their flying. Imprinting in birds cannot occur past the critical period.

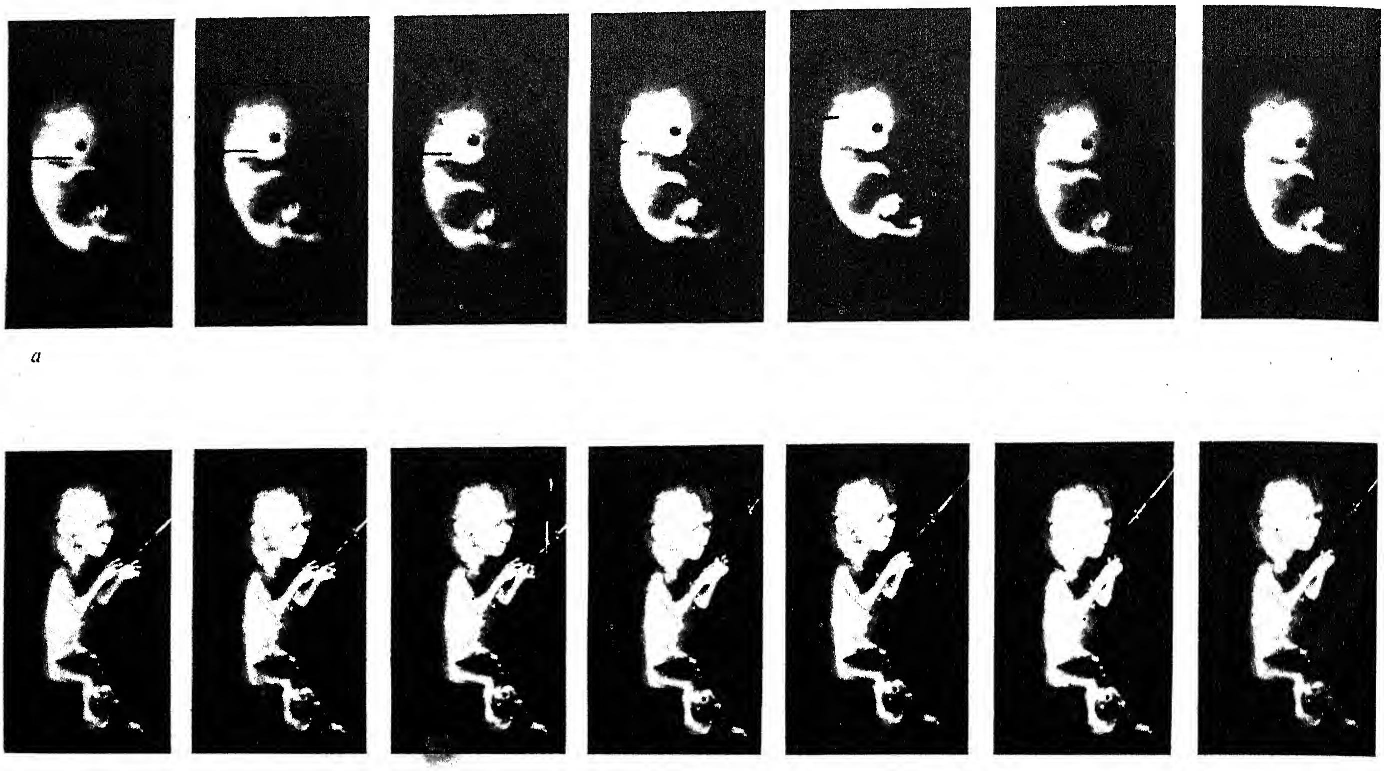
Genetic factors not only determine the type and patterning of maturing reactions but set upper limits on the abilities and skills that can be acquired by learning. No amount of special training will push an individual beyond his natural limits.

Much of the behavior of lower animals, especially invertebrates, can be thought of as maturational in character. The genetic-maturational factors in the development of an ant supply the fixed modes of response for its lifetime. In contrast, the genetic-maturational development of man makes for generalized organization of response, great flexibility in reaction, the ability to learn and think, a high degree of variability in motivation, and a tremendous capacity for social behavior and communication. To fit his activities to the varied demands of his physical and social environment, the human individual is more dependent upon learning than is any other animal.

NORMAL DEVELOPMENT IN THE FETUS AND NEONATE

Two methods have been used to study the behavior of the human fetus. Limited observations can be made by recording fetal activity from the abdominal wall of the mother. The second method involves direct observation of a live fetus removed by abortion to safeguard the health or life of the mother.

The Fetal Motor Sequence. The studies of Hooker on live human fetuses give a detailed account of maturation during the fetal motor sequence between the ages of eight and fourteen weeks.[14] The earliest



a

b

Figure 5.10. Fetal motor development. a. *An 8-week human fetus responded to stimulation with a mass movement of the upper trunk, shown in the changing relative positions of arm and head.* b. *At 14 weeks, a human fetus closed its fingers when a stimulus was applied to the palm.* (From Hooker, D. *A preliminary atlas of early human fetal activity.* Pittsburgh: Author, 1939.)

type of response that could be elicited by stimulation of the face was a *mass movement* of the upper part of the body. The photographs in Figure 5.10*a* are successive frames from motion pictures showing this movement as a lowering of the right arm in relation to the head. The arm itself did not move independently. By the age of eleven weeks, *reflex movements* could be observed in the arm and shoulder, in the rump, and in the neck. The fourteen-week fetus shown in Figure 5.10*b* closed its fingers when a stimulus was applied to the palm. It also flexed the elbow and raised the arm. When the face was stimulated in fetuses of this same age, movements of closing the mouth and reflex reactions of the tongue, neck, and muscles around the eyes occurred. Stimulation of the sole of the foot produced movements of the foot, fanning of the toes, and refined reactions of the foot and ankle. Except for some specialized reactions like breathing, vocalization, grasping, and reactions of the special receptors, all of the reflexes of the newborn child were observed in fetuses of fourteen weeks, although, of course, these reactions were sometimes faint and feeble.

This pattern of maturation from eight to fourteen weeks we have called the fetal motor sequence. The ages at which movements appear in the different orbits of action of the body are shown in Figure 5.11. The development of motor response after the appearance of the first mass movement is essentially one of progressive radiation of function to the finer terminal parts of the head and limbs.

The fetal motor sequence is a remarkable period in human life. Within the span of a few weeks, all the major forms of muscular movement develop. However, these fetal movements are different from the motions which appear after birth in that they are not specifically patterned by the objects and by the space factors that regulate postnatal behavior.

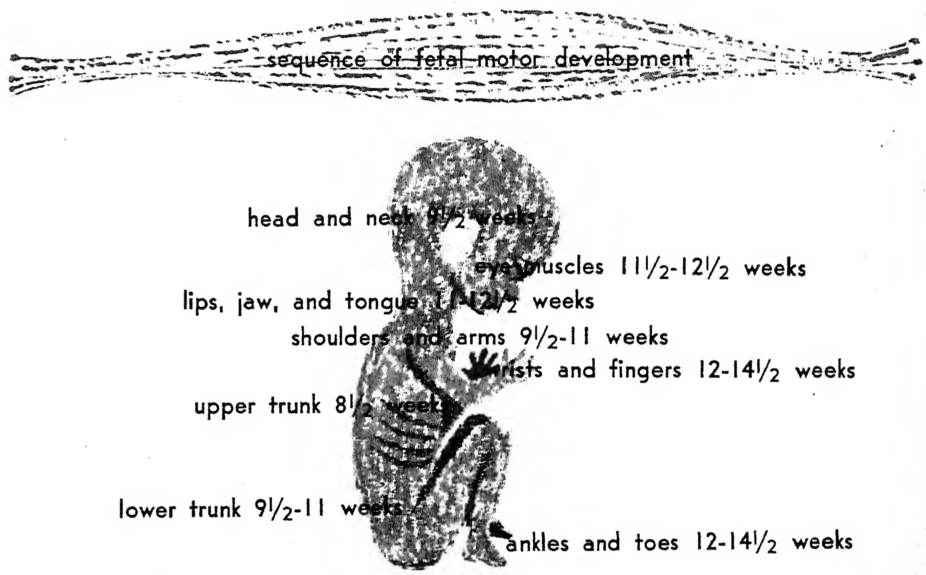
Individuation of Response. The nature of the first response in fetal life and its relation to subsequent development of behavior is important to our understanding of the nature of all psychological processes. There have been two generally opposed points of view about the nature of psychological development. The *integration* theory assumes that behavior originates as specific, discrete reflexes, which in time combine and integrate into larger, more complex patterns of behavior. According to the *individuation* theory, behavior appears first as an organized overall pattern, out of which more discrete responses develop.

The observations of Hooker, as well as a number of studies on animals, leave little doubt that the first movements of the living organism are of a generalized or mass character. At the age when the first mass movements appear in human fetuses, no independent movements of the arms or legs can be elicited. Specific reflexes of the arms and legs develop a few weeks later. Behavior originates as a total pattern of response, out of which progressively more discrete patterns differentiate. We shall see this same general-to-specific organization of behavior in many aspects of postnatal development.

Later Fetal Behavior. A very important theoretical problem of late fetal development is whether the unborn baby can learn. Besides our interest in establishing a zero point for learning, we want to know whether it is possible for prenatal or neonatal experiences to influence the course of development. A very limited kind of learning has been demonstrated in fetuses by means of the *conditioned response* technique, a method which is used to investigate the phenomena of learning as well as other psychological problems.

The essential procedure in conditioning is to take a response which is regularly given to a specific stimulus and attempt to elicit it through a new stimulus by presenting the two stimuli close together in time. In the fetal learning study it was established that late fetuses (about eight months and later) regularly responded with body movements to the sound of a loud clapboard, which we call the unconditioned stimulus. A vibratory stimulus applied to the mother's abdomen was used as the conditioning stimulus. At first, this vibration produced no response in the fetus, but after repeated

Figure 5.11. The fetal motor sequence. From 8 to 14 weeks, the human fetus develops movements of all parts of the body, proceeding from generalized mass movements of the trunk to more refined movements of the terminal parts of head and limbs.



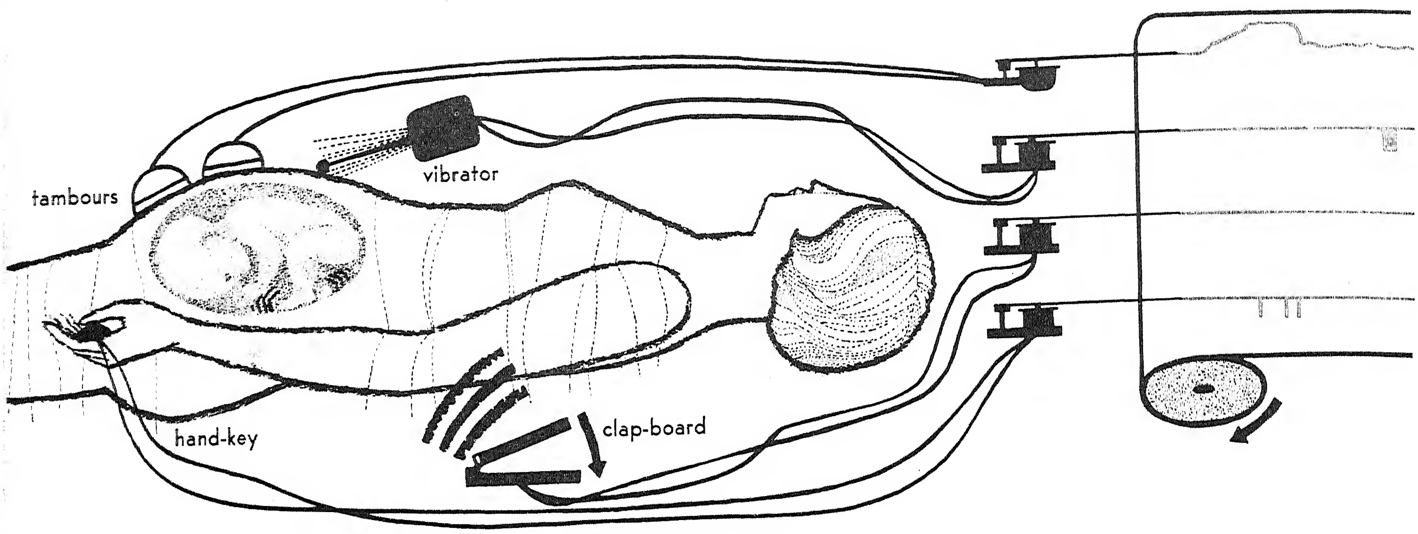


Figure 5.12. Conditioning the human fetus. Before conditioning, late human fetuses reacted to the sound of a clapboard. After a vibrating stimulus had been paired with the sound for a number of trials, the fetus learned to react to the vibration alone, as shown on the record. (Based on Spelt, D. K. The conditioning of the human fetus *in utero. J. exp. Psychol.,* 1948, **38,** 338–346.)

presentations of the vibration followed closely by the loud sound, vigorous fetal movements could be elicited by the vibration alone. As shown in Figure 5.12, the movements were recorded on a moving record from air-pressure recorders placed on the mother's body wall. An additional record was obtained by asking the mother to press a hand key when she felt movement.

Some evidence of conditioning, or learning, was obtained from five late fetuses. The record in the figure shows a test trial when the unconditioned stimulus, the loud sound, was omitted. Soon after the vibratory stimulus was presented, fetal movement was recorded through the air-pressure system, and the mother pressed her hand key, indicating that she felt movement. Conditioned responses were established in as few as fifteen to twenty trials, but were not usually very stable or consistent in appearance.

Behavior of the Neonate. The first month after birth is called the neonatal period, at which time the infant adjusts to postnatal conditions of relative physiological independence after his nine months of parasitic dependence on the maternal source. Sensorimotor structures which have matured during fetal life are activated for the first time. Almost all of the sensory mechanisms of the body except vision are well-developed in the neonate.[15] Many investigators have claimed that pain sensitivity is poorly developed in the newborn child, but others have found no marked differences between pain responses of the neonate and of infants.

The reflex behavior of the neonate is a source of wonder and often of consternation to parents. Although it is in general quite helpless, the newborn child exhibits a number of highly coordinated patterns of reflex activity. One of these is the *Moro reflex*—a generalized extensor reaction to loud sounds, jarring, or to sudden tactual stimuli. The arms are thrown outward and upward, the head is thrown backward, and the back is arched in a strong, almost convulsive action. The grasping reflex in the

neonate is a forced response to stimulation of the palm of the hand. Early in the neonatal period, the child can usually sustain his own weight by grasping an object with one or both hands. Responses to stimulation of the sole of the foot are variable, involving sometimes toe flexion and sometimes toe extension. The grasping reflex and foot (plantar) reflexes, as well as the Moro reflex, disappear during the course of early infancy. Thus maturation of behavior involves both the functional development and the functional suppression of movements.

Several experimenters have attempted to establish conditioned responses in neonates. In one study, eyelid closure, elicited by a flash of light, was conditioned to vibratory stimulation of the foot during the first week of life.[16] In another experiment, neonates younger than ten days were conditioned to withdraw the foot to the sound of a buzzer, when a light shock to the sole of the foot was used as the unconditioned stimulus.[17] Both of these studies reported that conditioned responses are difficult to establish in the neonate, and, if established at all, are highly unstable.

INFANCY AND CHILDHOOD

During the first few years of life, development of behavior goes on at a rapid pace. Almost overnight, individual personality seems to rise out of the vegetative order of the neonate's existence. In rapid succession the child is smiling, rolling over, reaching for objects, crawling about, babbling, and in general making remarkable adjustments to his physical and social environments. The acquisition of skills and emotional, intellectual, and social development depend on both maturation and learning. With increasing age, maturation assumes a less dominant, and learning a more dominant role.

The Postnatal Motor Sequence. The most outstanding feature of infant development is the *postnatal motor sequence.* We have said that fetal movements are unrelated to objects in space. After birth, the child must develop the basic patterned motions involved in locomotion, prehension and manual coordination, perceptual coordination, vocalization, and social behavior. His behavior must be fitted to the general dimensions and forces of physical space—gravity, movement, surfaces, and the contour and form of objects. During the first two or three years, all of the basic patterned motions involved in later adjustment in life are developed. In the neonatal period the child shows no distinctive movements in relation to objects and people in the world around him, except perhaps to suck at a nipple or to grasp, reflexly, small objects placed in his palm. When the postnatal motor sequence is near completion, the child is running about, jumping, climbing, taking things apart, playing with and reacting to other children and adults, talking, and displaying an almost endless number of highly complex motions.

The basic features of the motor sequence are maturational in character. The highly developed skills involved in postural control, locomotion, manual prehension, and vocalization depend on the maturing of all parts of the body—receptors, a skeleton and attached musculature which can support the necessary movements, and the nervous system. However, the skills, as they develop, also depend in part on learning.

In spite of many differences among

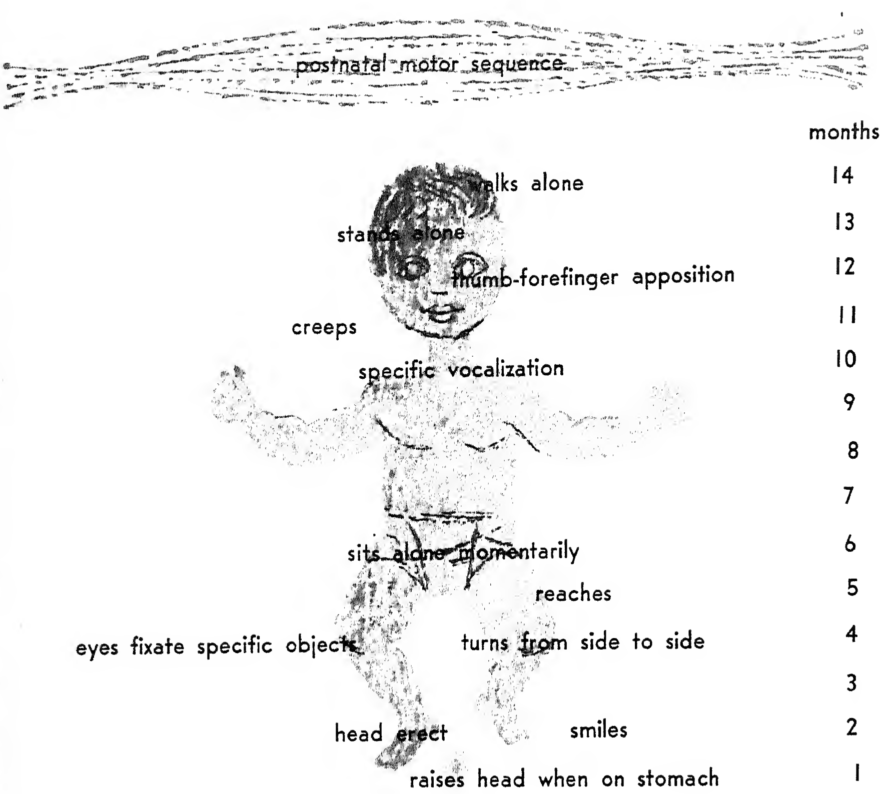


Figure 5.13. The postnatal motor sequence. The general pattern of maturational development during the first two years after birth is from larger, more generalized movements to increasingly finer movements of the head and limbs. Also, development proceeds roughly from head to foot, with coordinated movements of the eyes, mouth, and hands preceding coordinated movements of the feet.

babies, they follow the same general pattern of development. Figure 5.13 gives a simplified picture of the course of maturation during the first year of the postnatal motor sequence, indicating typical ages in months at which certain patterned movements appear. Development proceeds from larger, more generalized movements to increasingly finer movements in the more distal parts of the body. The baby first gains control of the large muscles of the upper trunk and neck. He can raise his head while lying on his stomach when he is about one month old. Soon he can raise his chest, and gradually thereafter develops movements of twisting and turning from side to side. By the time the child is six months old, he can sit alone momentarily, and from that time on acquires the progressively finer coordinations involved in crawling, creeping, standing, and finally walking.

The development of prehension, or grasping, proceeds from general control of the shoulders and arms to the finer reaching and grasping movements of the arm and hands. At five months the baby reaches for an object in a sweeping motion which may or may not attain its objective. Control of the arm is acquired gradually, so that a few months later the child can thrust his arm directly toward an object. Meanwhile the marvelous skills of the human hand are developing. At four or five months the thumb is beginning to be used in apposition to the fingers. The infant can grasp an object first with his whole hand and gradually with less and less of the hand being used. By the time he is a year old, he can pick up a small object with the tips of his thumb and fingers. He can use his thumb in complete apposition to any or all of his fingers, an ability which no other animal possesses. Figure 5.14 compares the reflex grasp of the neonate (*a*) with the grasping coordinations at six months (*b*) and at twelve months (*c*).

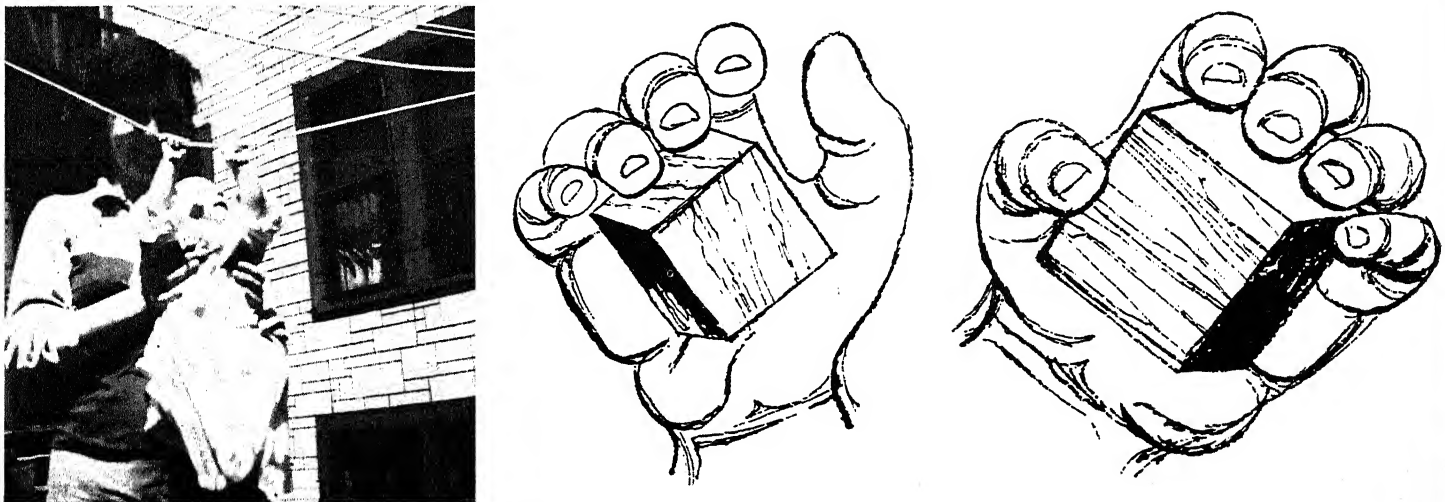
Another characteristic of the motor sequence is that development proceeds roughly from head to foot. Control of the head, neck, and shoulders comes before control of the lower trunk and limbs. Also, the development of fine coordinated movements of the face precedes development of fine coordinations of the hands and feet. The baby smiles (a true social smile) at two months or earlier, and can fixate objects with his eyes at five months, possibly sooner. This visual coordination means that a child can "grasp" an object with his

eyes many weeks before he can grasp it with his hands. Even the skills of vocalization develop at such a rate during the first year of life that the child is using his first word or two at ten or eleven months. Fine coordinated movements of the hands occur at about twelve months, and coordination of the legs and feet permits standing alone at twelve to thirteen months and walking about a month later.

The ages given in Figure 5.13 are typical of infant development, but should not be considered standards which must be met. Studies of early development point up the great variability that exists among children. Some babies walk at nine months or even earlier, while others wait until they are nearly two years of age. Some creep at five or six months, others when they are well over a year old, while some learn to walk first. Parents would do well not to worry about the pattern of development of their own child. The course of maturation cannot be forced. Furthermore, intelligence cannot be predicted reliably from the speed of motor development in infancy.

Emotional Development. We have been emphasizing a fundamental principle of development, the progression from general to specific patterns of behavior. This principle of differentiation applies also to emotional development. Although we shall discuss this process in more detail in Chapter 7, we can point out now that the earliest observable emotional reactions of infants are very general states of excitement. Only gradually can the more specific emotions be recognized.

Another important principle of development is that maturational patterns of response take on individual characteristics according to the child's own experiences. The emotional reactions known as fear can be observed in very young children, but the type of stimulating situation which provokes a fear response changes as the child grows older. Figure 5.15 shows the relative frequency of various fear situations in children of three age levels: up to two years, two to four years, and four to six years. The observations were based on descriptions of parents and teachers.



a *b* *c*

Figure 5.14. Development of grasping. a. *The reflex grasp of the neonate.* b. *At 6 months an infant grasps a block with his whole hand.* c. *At 12 months the block is grasped with the tips of the thumb and fingers. By this time the thumb can be used in apposition to any or all fingers.*

The fears which generally decrease in frequency with age are those of noise, strange objects and persons, pain, falling, high places and loss of support, and unexpected movement. In infancy, fears of noise, strange things, and pain are of greatest frequency. These emotional reactions are apparently independent of specific learning, for they occur regularly in babies and to some extent in young animals. Fears of animals, threats or danger of harm, and imaginary creatures generally increase in frequency from infancy through childhood. These changes in the nature of fear-provoking stimuli show how experience can modify early reaction patterns. Emotional reactions themselves depend on the maturing of the response mechanism, but the stimuli which arouse emotions can be learned. We shall have more to say about this in Chapter 7.

The Development of Language. Language is of interest to the psychologist from several points of view: as a form of social behavior, as an aspect of perception of sound and visual form, and as motor activity. Our interest here will be in the development of language as motor response. In a later chapter we shall consider other aspects of language and verbal behavior.

The two principal theories of language development in the child are known as the *root* theory and the theory of vocal *differentiation.* The root theory explains language development as a process of building larger blocks of vocal response through progressive combination and integration of smaller sound units. Compound word sounds and sentences are thought to be built up from the earlier developing root sounds. The more widely held differentiation theory holds that the verbal responses of language are differentiated out of early larger patterns of behavior. This is the sort of description that we have applied to the fetal motor sequence, the postnatal motor sequence, and emotional development. In each case large, generalized patterns of movement are followed by the development of increasingly finer, more discrete movements.

The principal stages in the development of language are illustrated in Figure 5.16. During the first few months of life, there are many vocal sounds—grunts, cries, and coos—and syllable sounds which occur as a part of general emotional and social behavior. As shown in Figure 5.16*a*, these early vocalizations come to serve as a

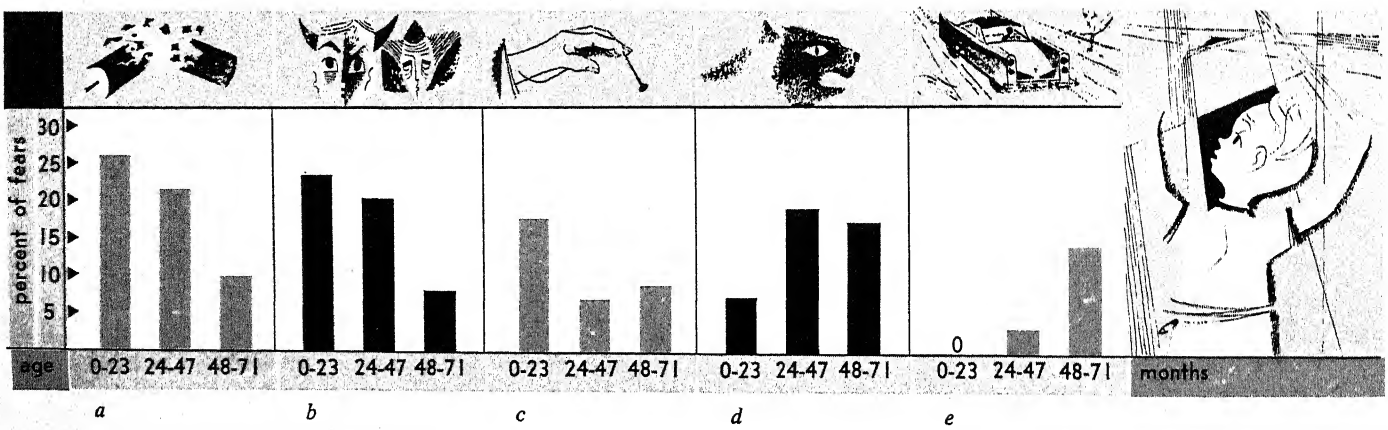


Figure 5.15. Children's fears. The nature of fear-producing situations changes with age. Noises, a, *strange objects and persons,* b, *and pain,* c, *produce fear reactions more readily in younger children, while animals,* d, *and threat of danger or harm,* e, *produce fear more frequently in older children than in the younger.* (From Jersild, A. T. and Holmes, F. B. Children's fears. *Child Dev. Monogr.*, 1935, No. 20.)

limited means of communication with other persons. The baby's crying indicates distress and usually gains attention for him. Consequently, he may learn to use his cry to get attention from his mother.

As the child's vocal apparatus matures he enters the babbling stage (Fig. 5.16*b*). Now he repeats over and over specific sounds, such as *mamamama,* or *dadadada.* Although his repertoire of consonants is limited at this time, he seems to be able to utter most of the vowel sounds of the language spoken in his own home as well as the other languages of the world. An important factor in his development is that he hears his own sounds and hears the words of the people around him. Before the child says a single word plainly, he may carry on long "conversations" with a parent or sibling, using these babbling sounds, accompanied by adjustive social activities such as smiling, gesturing, reaching, and following others.

These early articulations of the infant are not attached to specific objects, and do not have specific meaning. In the third stage of language development (Fig. 5.16*c*), toward the end of the first year, the child learns to use certain of his vocalizations as words. It is not always easy to identify the first word of the child, but it should have these three features: it should be a specific sound, it should be attached to some object or person, and it should sound something like a word that others use. The first word is not entirely new in the child's life, but is one of his babble sounds that he has isolated to some degree and attached to an object. This attachment has come about because he has uttered the sound in relation to the object one or more times. When the mother (or other person) hears the sound, she repeats it but changes it a little to make it sound like a "real" word. She reinforces the meaning of the word by using it in relation to the specific object. The child imitates the word as spoken by his mother within the limits of his vocal ability.

The improvement in ability to speak during the second and third years of life is not entirely a matter of learning new

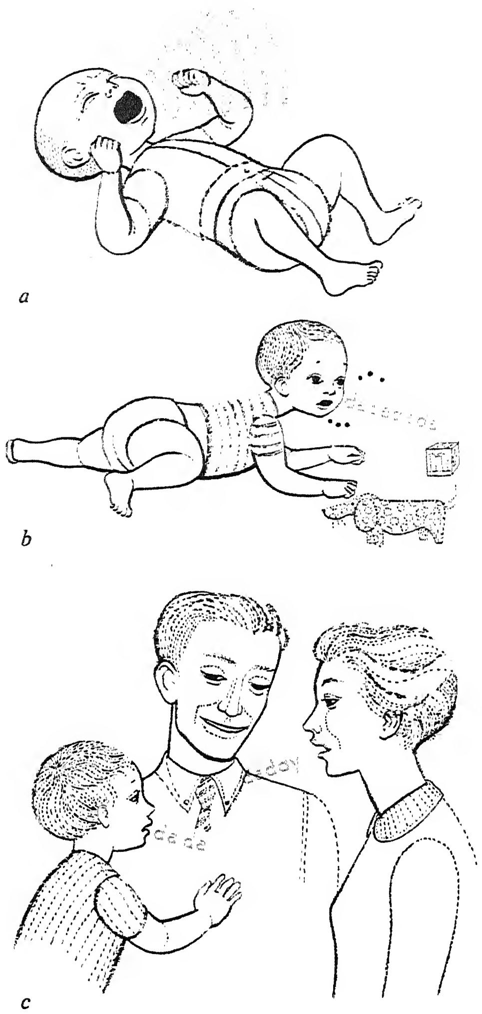


Figure 5.16. The development of language. a. *Early vocalizations are general emotional responses that come to serve as a limited means of communication.* b. *During the babbling stage, syllables are articulated, but are not attached to specific objects.* c. *Toward the end of the first year, specific vocalizations are used as words.*

words. The reproduction of the sounds of a language requires the very finest articulatory movements of neck, larynx, throat, tongue, and lips, which are not fully developed until well into the second or third year, often later. The earliest movements of vocalization are larger movements of the chest and diaphragm to expel air through the vocal canal. The child first recognizes and tries to reproduce overall patterns of words and phrases—that is, the "breath groups" of spoken language—rather than the phonetic detail.[18] For example, he understands the word "water" and reproduces its general pattern and inflection, although it may come out "wa-wa." The movements of speech are from the beginning an organized system, not a collection of separate details.

Once the child starts to talk, the growth of vocabulary goes on so rapidly that the ordinary parent cannot follow the change. In the first year the average child learns three words. In the second year he learns about 270, and then about 600 words every year until he goes to school.[19] Once in school, he picks up about 1000 words each year throughout grade school.

Symbolic Learning. The ability to learn—that is, to modify patterns of response as a result of behavioral experience—is an almost universal characteristic of animal behavior. We have seen that limited kinds of learning can take place in the human infant even before birth. However, the amazing capacity of the human individual for mental growth, as evidenced by his ability to acquire an almost limitless fund of knowledge and to carry on problem solving and other activities by means of abstract thought, depends on the use and retention of symbols. Much of human learning proceeds in terms of symbolic processes, using the tools of language and other symbols to facilitate the learning process. The development of language in the young child proceeds hand in hand with the ability to think abstractly.

Delayed reaction. One of the simplest methods of testing whether or not an animal or child can use symbolic actions to guide his responses is the delayed reaction, a technique used originally by Hunter in 1913.[20] The procedure is to train an animal or child to respond differentially in a choice situation according to a stimulus signal, and then to interject a delay period between the stimulus and the response. Hunter's subjects were first taught that they would receive food at the lighted one of three doorways, and then were tested for retention by restraining them for a time after the light had been turned off. Rats could respond correctly after a delay of only about ten seconds; cats, dogs, raccoons, and children, after a progressively longer delay. In children, the ability to delay shows improvement with age, and appears to develop with the use of effective language.

The development of delayed response ability in young children is shown in Figure 5.17. More than 800 children at eight age levels, from one and one-half years to five years, were tested. The child was seated before three boxes, in one of which the experimenter hid a toy kitten. Then a screen was placed over the boxes and ten seconds were counted off before the child was allowed to "find the kitty." The bar graph in Figure 5.17 shows the percentage of children at each age level who passed the test three successive times. Only 15 percent of the one and one-half year olds passed, and 46 percent at age two. By the

age of three and one half, almost all of the children succeeded.

Double alternation. In the delayed reaction situation, the differential stimulus is an external one—the lighted door for Hunter's rats or the kitten in Figure 5.17. A more difficult situation is to learn to respond differentially when the only stimulus signal is *within the organism*. For example, in an alternation problem, a rat or other subject must learn to respond first to the right and then to the left, and so on, RLRL. Here, the only cue for the next response is in the *last* response made by the subject. A double alternation problem, requiring two responses to the right then two to the left, is almost impossible for a rat to learn, although some higher animals are able to learn it.

The ability to learn a double alternation problem was studied in children from two years of age to six years nine months.[21] The child sat before two boxes, while the experimenter, behind a screen, placed candy rewards in the boxes in the sequence RRLLRRLL. If the child opened the wrong box first, he was permitted to open the correct one and get the candy. A child was considered to have learned the double alternation if he gave twenty-four consecutive correct responses. The youngest child to achieve this criterion of learning was three years seven months, although a few younger children performed short series of double alternations. Like the delayed reaction, the double alternation is based upon some elementary symbolic representation to the individual of events that have gone on before. We can conclude from these developmental studies that children below the age of three or three and one half are typically limited in the basic symbolic mechanisms of recall.

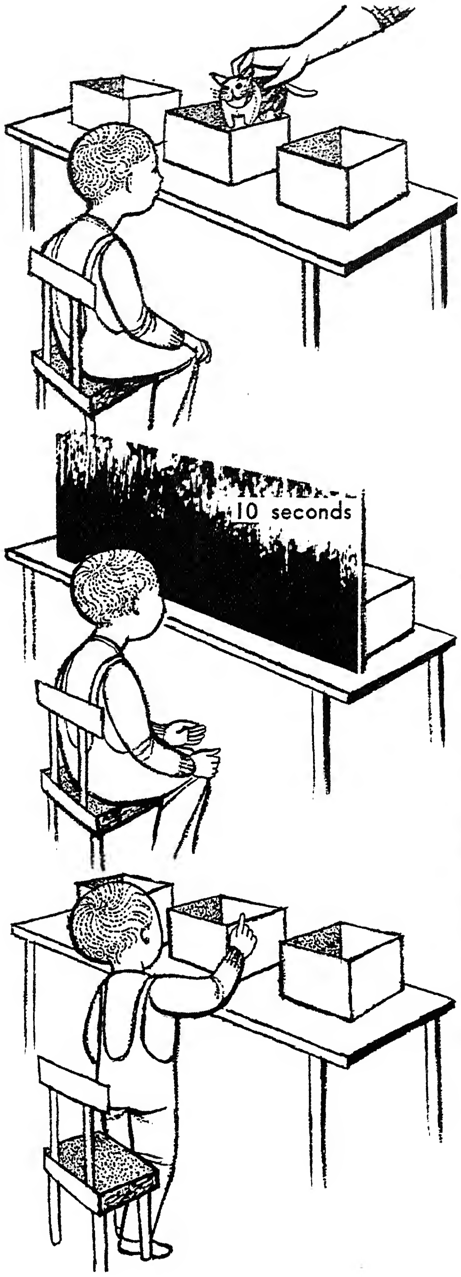
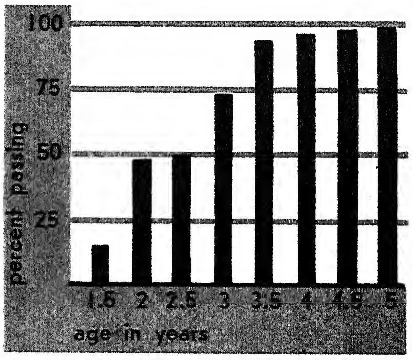


Figure 5.17. The delayed reaction in children. Symbolic processes in children can be tested by the delayed response. A child watches the placement of a toy kitten in one of three boxes, and after a delay of 10 seconds is asked to "find the kitty." The bar graph shows the percentage of children at each age level who passed the test three successive times. (Data from M. A. Merrill, as quoted in Hunter, W. S. and Bartlett, S. C. Double alternation behavior in young children. *J. exp. Psychol.*, 1948, **38,** 558–567.)



SUMMARY

There are two processes of development: maturation and learning. Maturation is the differentiation that occurs independently of experience; learning is the change in behavior that results from behavioral experience. Both kinds of development are determined by hereditary and environmental factors.

Hereditary factors are carried in the chromosomes of each living cell. The sex of an individual is determined by one of the 24 pairs of human chromosomes; an XY pair produces a male, while an XX pair produces a female. The genes contained in the chromosomes are also paired, with one usually dominant over the other. The dominant gene influences development. The only individuals with identical hereditary factors are identical twins or other multiple births that develop from a single fertilized egg. Differences in identical twins we attribute to environmental factors.

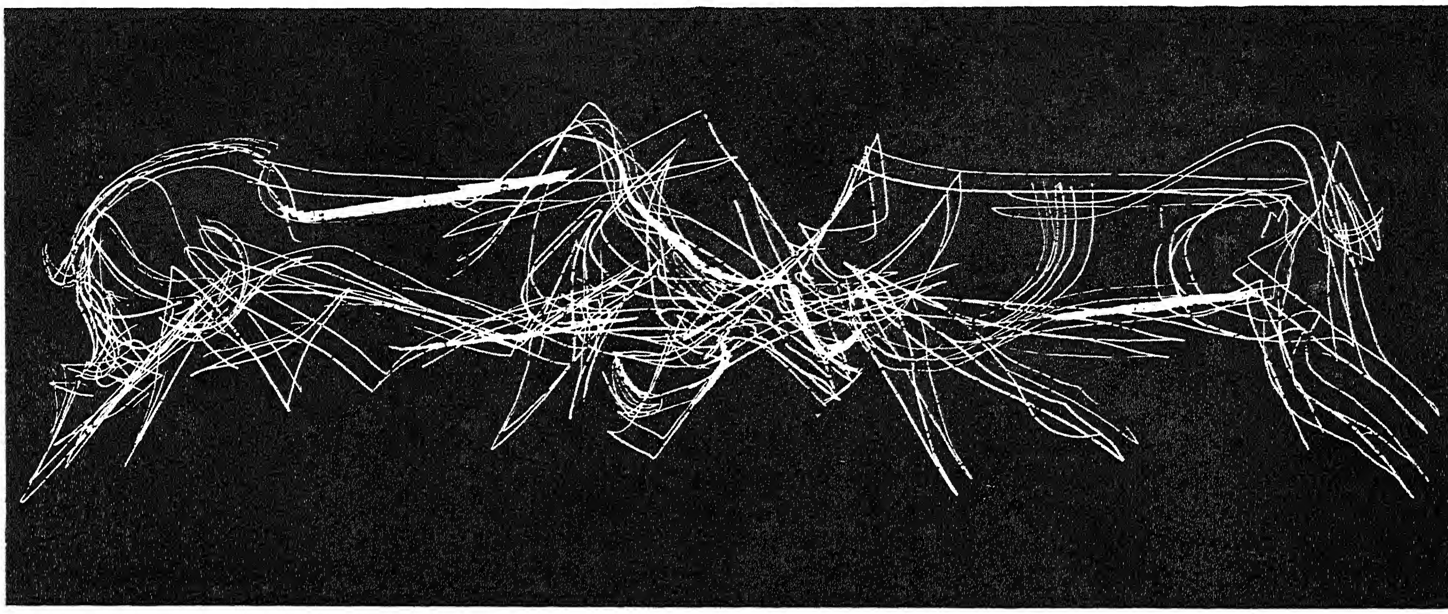
Evolution is the result of genetic mutation and the processes of natural selection. The evolution of body structure and the nervous system is paralleled by the evolutionary changes in behavior.

Genetic factors, operating in an adequate environment, determine the type of reactions that mature and the rate of maturation, as well as setting upper limits on abilities. In his development, man is much more dependent on learning than are any of the lower animals.

Early restriction of environmental opportunities can result in perceptual, emotional, social, and intellectual retardation.

Maturational development of behavior proceeds from general patterns of response to the more specific, discrete responses in motor skills, emotional reactions, and language.

Although learning has been demonstrated in fetuses and newborn infants, it is not usually a significant factor until after the neonatal period. Symbolic behavior is limited before the age of three or three and one-half years.



CHAPTER 6. HUMAN MOTIVATION

The behavior of man is an interplay between two worlds: the external environment and the internal environment of the body. The external environment as it is known through perception is made up of objects, of people, of parts of the body, of forces, and of movement arranged in the pattern that we call the "real" world. Inside the skin exists the second environment—the internal bodily environment—the domain of cells growing and dying, of metabolic exchanges, of hormonal secretions, of physiological states. From both the external and internal realms arise the motives, the needs, the burning desires, and the powerful sources of energy that transform the human system into a living personality in action.

Nature of Motivation. As we learned in Chapter 4, behavior is marked by the relatively slow and gradual changes in level and direction of activity which are related to the internal chemical states of the body and to the neurohumoral regulatory mechanisms. It is this characteristic of behavior that we call motivation. Motivated behavior is persistent, it is often periodic, and it is goal directed. Motivation refers to such diverse patterns as love, hate, hunger, thirst, pain, political ambitions, or artistic efforts. The ongoing patterns of behavior are made meaningful by the motives around which they are organized.

There are three characteristics of motivated behavior: (1) the drive condition, (2) the pattern of motivated activity, and

(3) the incentive or goal. The drive condition may be either internal or external. The drive conditions for hunger and thirst typically lie inside the body. The drive conditions for emotionally motivated behavior may be external, such as that of a painful stimulus.

Although for convenience we discuss different motives separately, the pattern of motivated behavior at any given time results from the combined effect of the different drive conditions acting on the organism. When we sit down to eat a meal, our behavior is related to hunger and thirst, as well as to more subtle perceptual, emotional, and social motives. A motive never exists independently, but only within a pattern of other motivating conditions. For example, the emotional state of the individual helps define the responses made to other drive conditions.

Goals or incentives are objects or situations toward which the motivated behavior is directed. Food is the incentive for hunger; water, or some wetting agent, is the incentive for thirst. At any given moment, motives are usually directed toward specific incentives or goals.

Man's motives develop continuously during his lifetime. They change with maturation. They change with learning. They change with the influence of thought and attitude, with the processes of aging. Nevertheless, all forms of motivation, however varied and variable they may appear in different personalities and different patterns of adjustment, have a similar beginning for all individuals. The infant is endowed at birth both with the complex mechanisms that underlie physiological drive states and with the interacting glandular systems that regulate emotional-motivational activity. In the young infant the pattern of motivated behavior is random and diffuse, seemingly undirected. The hungry baby must learn that a nipple is a goal. It is through experience that motives become organized with reference to the physical and social environment.

SPECIFIC MOTIVES

By specific motives we mean those that are typically related to particular types of incentives or goals—motives such as hunger, thirst, sex, temperature regulation. The three aspects of motivation—the drive condition, the incentive, and the motivated activity—are more clearly defined in these specific motives than in our more general motives. A number of specific motives are represented in Figure 6.1.

Homeostasis. In order to understand the relationships diagrammed in Figure 6.1, we should consider first a physiological principle known as *homeostasis*.[1] Homeostasis refers to the tendency of the body to maintain a steady internal state. Any disturbance of the internal state activates the compensating bodily mechanisms to restore the balance. This principle can be understood most clearly in relation to the automatic physiological processes which maintain a fairly constant bodily temperature, chemical composition of the tissues and fluids of the body, and so on.

Homeostasis also has meaning as a principle of psychological motivation, illustrated in Figure 6.1 as the balancing role played by motivated behavior in maintaining internal drive states in relation to environmental incentives. For example, when the body needs water, changes occur which induce thirst and motivate the individual to seek the corresponding incentive—some-

thing to drink. The drinking activity acts to restore the internal balance. The motivated activity is not necessarily a completely automatic thing, since, in this case, the individual must direct his activity toward finding something to drink. The body's need for oxygen is balanced by the activity of breathing, which, on the other hand, usually functions quite automatically. In unusual cases of oxygen deprivation, however, the motivated activity is likely to include certain learned modes of response. Persons at high altitudes restrict their activity, and most people, if trapped in a burning building, would know that the oxygen supply is better near the floor. Thus the compensatory mechanisms called into play to maintain a constant internal state include both unlearned and learned activities.

Other activities indicated in Figure 6.1, besides drinking and breathing, are eating, excretion, and sex activity. Eating is the motivated activity which compensates for food reduction in the body. The physiological drive state is hunger and the incentive sought is food. The drive for excretory activity is related to the pressures of waste products in the bladder and colon. Although the excretory drive is quickly satisfied in the infant, it soon becomes associated with the incentives of socially correct equipment and environment. Sex activity serves to reduce internal sexual drives with the incentives of sex partners or other sexually meaningful situations.

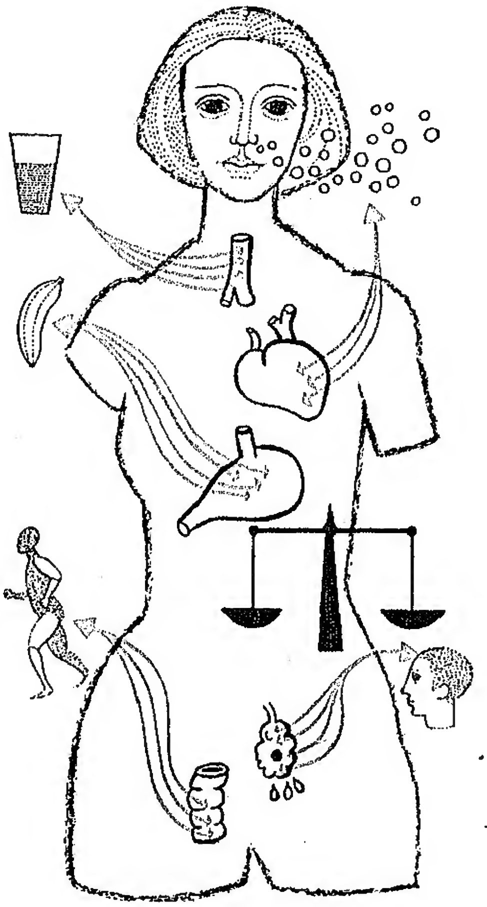


Figure 6.1. Specific motives as homeostatic mechanisms. The basic physiological drives tend to maintain the body at a constant internal state. Although some homeostatic mechanisms (e.g., oxygen balance) are relatively independent of learned patterns of adjustment, most of them depend upon learned activity and reflect general adjustive behavior.

Hunger. A great deal of human activity is motivated, either directly or indirectly, by the organism's need for food. Wherever food is plentiful, people are apt to forget how powerful the hunger motive can be. When the body's food needs are not satisfied, however, the hunger drive soon dominates the individual's activity. As we saw in Chapter 2, subjects in starvation experiments showed marked changes in emotional and social behavior, and food seemed to them the most important thing in life.

The earliest systematic observations on hunger were made over a hundred years ago on a man who had suffered a bullet wound that exposed the inside of his stomach to direct observation. The attending doctor observed that when the man was

hungry, his stomach showed sharp contractions, and that when food was placed in the stomach, these contractions stopped.

Many years later the physiologist Cannon carried out laboratory studies to determine whether stomach contractions correlated with reported hunger pangs. The method he used is shown in Figure 6.2. So that records of the stomach's contractions could be obtained, the subject swallowed a balloon attached to a rubber tube which made it possible to inflate the balloon inside the stomach. Once he had adapted to having an inflated balloon inside his stomach, experimental observations could be made. The tube from the balloon was attached to a marker which recorded changes in air pressure on a moving record. Another marker was connected to a key held in the subject's hand. The hungry subject pressed the handkey every time he noticed a hunger pang, while the gastric balloon sent out signals reporting on conditions within the stomach. Cannon's records showed that when a large stomach contraction occurred, a hunger pang was reported by the subject, as shown in Figure 6.2.

Although these experiments demonstrated that stomach contractions are a part of the bodily activity ordinarily associated with hunger, further research and observations of several different kinds have shown that local activity of the stomach is not the decisive factor in the hunger drive. Rats with their stomachs removed not only became hungry and ate, but learned mazes and other problems on the basis of food rewards.[2] Human patients with complete surgical removal of the stomach report that they still "feel hungry." Furthermore, hunger-motivated activity in rats remained normal even after the sensory nerves leading from the stomach to the brain had been cut.[3] In such cases, the activity of the stomach could not serve as a hunger stimulus, since there were no neural pathways over which a sensory message could be sent.

Recent studies have shown that the critical factor in hunger motivation is the sensisivity of the central area of the hypothalamus to the availability of blood sugar.[4] When the body's need for sugar is satisfied, the cells in this area take in glucose and inhibit further eating. If this area of the hypothalamus is injured, there is a constant, voracious appetite. Apparently, eating activity is initiated by stimulation from the lateral area of the hypothalamus unless this activity is blocked by the "satiety" cells in the central area.

In Chapter 4 we pointed out the importance of the hypothalamus as a regulating mechanism in emotional and motivational activity. Besides being involved in regulating the general level of activity, the hypothalamus also serves to regulate behavior as specific as eating. In fact this neurohumoral center influences many kinds of motivated activity, as we shall see.

Partial hungers. One interesting aspect of hunger motivation is that both animals and people have very specific appetites for certain kinds of food. Animal breeders have long known that animals will go to great lengths to satisfy their discrete hungers. We all know that in order to survive, the organism needs what we call a "balanced diet," including vitamins and minerals as well as other food elements. If an individual is deprived of certain of these substances, he develops specific hungers for them.

In a study of the nature and regulation of various partial hungers, groups of white

rats were put on diets which were normal in every respect except that one food element was missing.[5] When the animals then were given access to several different food elements, they showed a preference for the one missing from their diet. By this method it has been shown that partial or specific hungers exist for sugar, protein, thiamin, riboflavin, salt, phosphorus, sodium, and calcium. Although we don't know the mechanisms underlying all of these hungers, we know that calcium hunger is regulated by the parathyroid glands, and salt hunger by the cortex of the adrenal gland.

The phenomenon of partial hunger can be shown to operate in the hunger motivation of the young child. In a well-known study, several newly weaned infants were permitted to select their complete diet from a variety of foods placed before them on a tray.[6] Over a period of months they all ate a balanced diet and developed normally although the selection of foods varied from time to time and from child to child. A child might eat nothing but spinach at one time, but later shift to other foods. One of the children who was rachitic at the start of the experiment chose to eat cod-liver oil until his rickets had been checked. However these children were offered only foods that were considered suitable for their age. Many mothers would contend that the partial hungers are not completely reliable when a child has access to unlimited sweets and other tempting foods that are inferior in food value. Even animals do not always select the "best" diet if given a choice. The partial hungers are effective in some circumstances, and with some food substances, but have their limitations.

The hunger motivation of children is influenced by learned habits often based more on emotional motivation than on hunger. If mealtime is an unpleasant occasion, or if the parents try to force the child to eat his prescribed meal, the emotional tension built up in him may so dominate his behavior that the hunger drive does not operate. A normal child allowed to eat in a relaxed atmosphere is likely to prefer a good selection of foods, although specific preferences may come and go.

The hunger drive. The bodily basis of hunger motivation probably includes a number of interacting neurochemical mechanisms. According to the hypothalamic theory described above, the stimula-

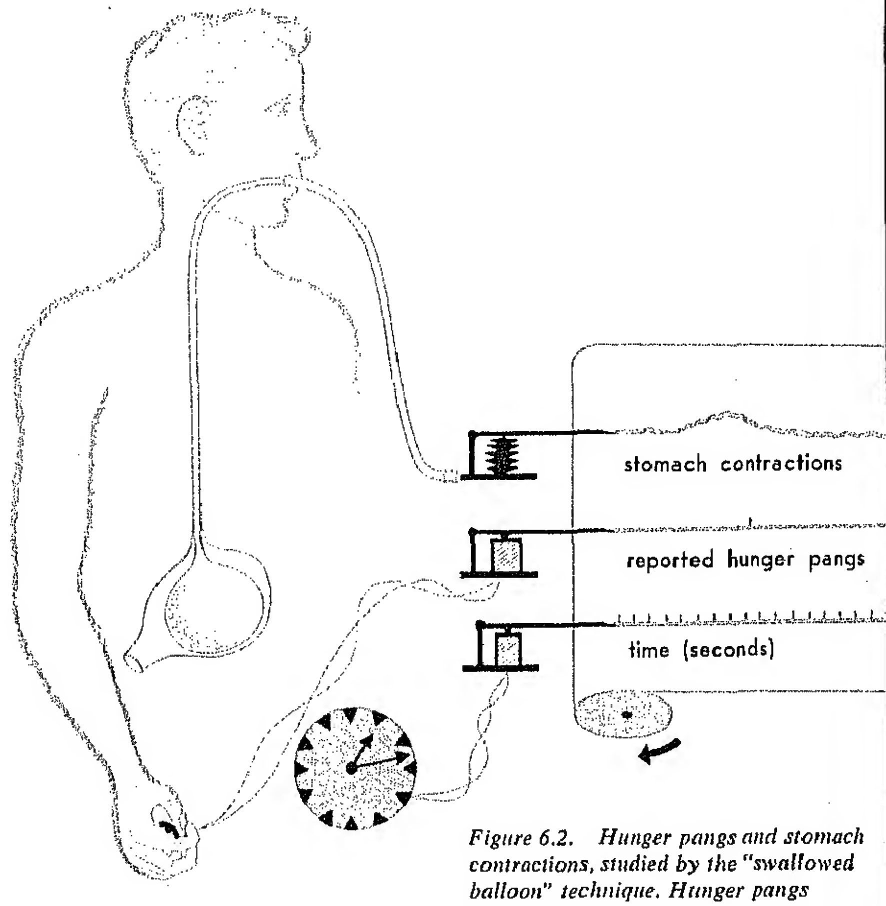


Figure 6.2. Hunger pangs and stomach contractions, studied by the "swallowed balloon" technique. Hunger pangs reported by the subject occur during large contractions of the stomach. (Based on Cannon, W. B., and Washburn, A. L. An explanation of hunger. *Amer. J. Physiol.*, 1912, 29, 441–454.)

tion to eat is provided constantly by the lateral area of the hypothalamus, unless *inhibited by the satiety cells of the central* area. Destruction of the lateral areas causes an animal to refuse food, while injury to the central area results in a constant appetite. Since the cells in the central area are *sensitive to glucose, any disturbance in the* body's ability to utilize sugar can upset the hunger regulatory mechanism. Diabetics have a ravenous appetite, even though their blood-sugar level is high, because they cannot *metabolize sugar normally without* insulin.

In addition to this hunger mechanism related to sugar metabolism, hunger motivation is complicated by the partial hungers for certain *food elements*. When a deficiency in one of these foods exists, the individual is motivated to seek and eat that particular food. However, there are some inadequacies in this system, for apparently the body is not able to regulate its diet perfectly.

Hunger, appetite, and habit. Hunger-motivated activity, like other forms of motivation, is defined as much by learning as by physiological drives. In a society such as ours, where the food supply presents more problems in its abundance than in its scarcity, our eating habits seem to be based less on basic food needs than on learned preferences. How can tastes for special foods be explained?

Neither bulk food hunger nor the partial hungers can explain the individual differences that exist in appetites and taste. Some of these differences undoubtedly are due to availability of foods; e.g., rice is the basic food in the areas of the world where it is cultivated on a large scale. Other differences in taste are based on cooking habits or other customs of cultural groups. The highly seasoned foods served daily in some countries do not usually appeal to people accustomed to a bland diet. Religious taboos set up strong aversions to some foods. Also, people express aversions to foods that they have never encountered —horse meat, dog meat, rattlesnake or eel, *for example*. The mere "idea" is distasteful, they say. A learned aversion to a certain food may be strong enough to cause nausea and vomiting.

Habits of eating often become far re*moved from the principle of homeostasis*— the maintaining of a constant internal state. Ideally, a hungry individual should eat just enough to satisfy his food needs, and then stop eating. In many of us this ideal control of *food intake seems to be the exception* rather than the rule. We see on one hand the problems created by habitual overeating, and on the other the less frequent problems created by emotional inability to eat.

In recent years the theory has been popularized that overeating is a result of some basic anxiety or maladjustment. If emotional tension in the individual is relieved by eating, there is almost constant motivation to eat. There is probably some truth in the theory, but it does not give a complete explanation for overeating. Individuals differ in their food needs because of differences in general activity, metabolic processes, and hormonal balances. Instances of overweight found in very young children suggest that the underlying physiological pattern may include some disturbance in the partial-hunger system. In adults, putting on weight is usually associated with decreased bodily exercise. As people grow older, become less active, and consequently need less food, they should readjust their eating habits to changing needs.

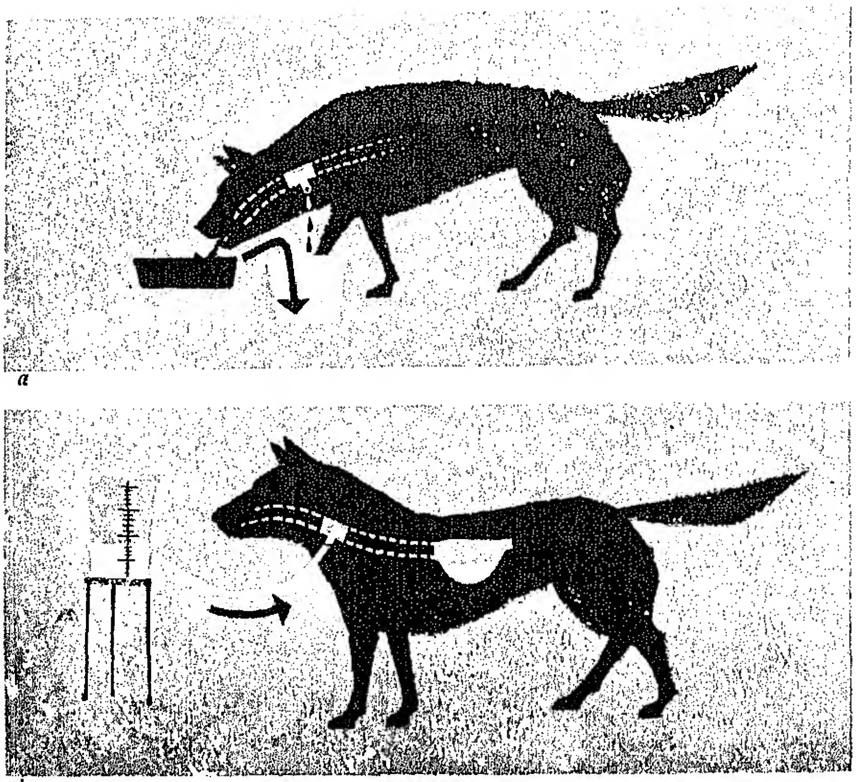
Thirst. Some years ago a university farm expert found a question from a farmer in his mail: "What makes a cow start to drink and what makes her stop?" This question is not as simple as it first appears. The more we examine the problems involved in understanding the motivational basis of thirst, the less ready we are to give the farmer a quick answer.

Thirst as a motivating condition is more rigorous in its demands than hunger. Although individuals have survived long periods of food deprivation, the tolerance of the human organism for water deprivation is very limited. A person may live without water for several days, or, if he is unfortunate enough to be on a hot desert without water, he may live but a few hours. Survival is dependent on the amount of water lost from the body. It is estimated that a human individual cannot survive a water loss of more than 20 percent of his body weight.

Under certain abnormal conditions thirst can become a powerful and cruel drive. A victim of the relatively rare disease, *diabetes insipidus*, a condition involving the pituitary gland, is subject to a constant tormenting thirst related to excessive urination. His daily water intake may be measured not in cups or quarts, but in gallons. If water is not available, he is driven to drink any liquid that comes to hand. An individual stranded in hot desert country without water undergoes progressive physiological and psychological deterioration.[7] He first becomes thirsty, then uncomfortable and irritable. As he acquires a "cotton mouth" and his skin begins to shrink, he talks to himself and has hallucinations. Later he cannot speak but only moans or bellows. He tears his clothes and bites his arm to suck blood. As he approaches death he becomes a senseless automaton.

Thirst motivation is the homeostatic mechanism by means of which the normal organism tends to maintain its water balance at a constant level. The body is constantly losing water—by perspiring, by the evaporation of water in the respiratory tract, and by urinating and defecating. Water loss is reflected in the condition of all the body tissues, but we associate thirst particularly with the local dryness of the mouth and throat. When the body needs water, less saliva is produced by the salivary glands, and a dry mouth results. Drinking of water has the immediate results of wetting the mouth and throat and partially filling the stomach. Within fifteen minutes or so the water finds its way to the various tissues of the body, thus restoring the water balance.

The sequence of events from water loss to its restoration through drinking is subject to many variables at every stage. The amount of perspiration, for example, is related to the body's temperature controls, to conditions of emotional stress, and to other factors. The absolute water content of bodily tissues is not always as important as the relative water content—relative, that is, to certain solids, notably salts. It is common knowledge that eating salty foods leads to thirst and to drinking more than normal amounts of water. Forced restriction of water intake has marked effects on the various bodily mechanisms connected with water balance. Human subjects who were restricted to 30 or 60 percent of their normal water intake over a period of days adapted remarkably well to this deprivation.[8] They stopped perspiring almost completely and showed a rise in body temperature.



a

b

Figure 6.3. The experimental study of thirst motivation and drinking behavior. a. *A dog drank enough to equal its water deficit even though the liquid passed out through a tube in its esophagus.* b. *Water introduced directly into the stomach did not allay thirst immediately, but only after about 15 minutes, when the body tissues had been replenished.* (Based on Adolph, E. F. Measurements of water drinking in dogs. *Amer. J. Physiol.*, 1939, **125**, 75–86; Bellows, R. T. Time factors in water drinking in dogs. *Amer. J. Physiol.*, 1939, **125**, 87–97.)

Physiological basis of thirst. To get back to the farmer's question of what makes a cow (or dog, or man) start to drink and what makes him stop—we can say quite a bit about what starts drinking, but practically nothing about what stops it. According to the local theory of thirst, dryness of the mucous membranes of the mouth and throat, resulting normally from reduced salivary secretions, is the basis of thirst-motivated activity.[9] There is some evidence to support this view. Wetting the mouth or anesthetizing the skin of the mouth and throat seems to assuage thirst, at least temporarily. Furthermore, people who take atropine, which produces a dry mouth by stopping the salivary flow, become thirsty. On the other hand, there is much evidence to show that a dry mouth is not the only condition underlying thirst. Pilocarpine is a drug which produces a profuse flow of saliva, but if it is given to a dehydrated person it does not eliminate thirst. In this case, wetting the tissues of the mouth and throat has no lasting effect on the motivation to drink.

We have learned to respond to a dry mouth as a signal for water need, but under conditions when this signalling mechanism gives false reports of the conditions of the body, water need still motivates us to find and drink water. It has been shown many times and in many ways that thirst occurs during a state of dehydration of the body tissues. Just how this dehydration triggers drinking is not known, but here again the hypothalamus plays a mediating role. There are cells in a hypothalamic center which are sensitive to changes in the osmotic pressure of body fluids and which thus initiate thirst-motivated activity when the body needs water.

We have been speaking of a "triggering" mechanism of thirst which starts drinking. But what controls the amount we drink? What makes us stop? Some classic experiments on dogs describe the nature of the problem. Dogs are highly precise in regulating their water intake, normally drinking just enough to make up their water deficit. When experimental dogs were deprived of water for different lengths of time and then given free access to water, they replaced their body water loss almost to the ounce.

A number of dogs were then prepared with tubes inserted into the esophagus, as shown in Figure 6.3. When a dog drank (Fig. 6.3*a*), the water was diverted into a vessel. Water could be introduced directly into the stomach through the fistula, as in

Figure 6.3*b*, bypassing the mouth and upper throat. It was found that dogs deprived of water drank just enough to make up their deficit, even though the water did not get into their stomachs. Of course, if they were not given water to make up the water loss in body tissues, they soon started drinking again, taking enough at each drinking to make up the cumulative deficit. If water equal to their water loss was introduced directly into the stomach through the fistula (Fig. 6.3*b*), it did not allay their thirst immediately. The dogs would drink if given access to water immediately afterward, but after a delay of fifteen minutes they would not drink. In this time the water had found its way into the body tissues so that the animals were no longer thirsty.

The dog shown in Figure 6.3*a* seems to know just how much water he needs, drinks it and stops, even though he loses it through a tube to the outside. What makes him stop drinking? We can only speculate on the control mechanism. It can be either a predetermined control or an immediate control brought about as the water is being drunk. By a predetermined control we mean that the thirst motive exists at any given time at a certain strength, and that the amount of water taken corresponds to the strength of the drive. The other possibility is that water passing through the mouth and throat produces local changes in the tissues which at the proper time cut off the drinking activity. It seems unlikely, however, that either the initiation or the termination of drinking activity is entirely dependent on local conditions of the throat tissues. The body's need to maintain its water balance is a critical one, and the control of thirst and drinking is extremely complex, involving a number of interrelated mechanisms.

Temperature Motivation. The mammalian organism must maintain its internal body temperature within very precise limits despite constantly changing conditions of the external environment. There are a number of processes which occur automatically within the body to help it conserve heat or lose heat, as required. In addition, a multitude of learned behavior patterns—the use of clothes, of houses, and of heating and cooling devices—are related to temperature control. The success with which man's civilizations have dealt with the problems of heat and cold tends to make us overlook the basic importance of temperature motivation.

The most important of the unlearned or automatic temperature-regulating reactions, as well as some of the learned reactions, are represented in Figure 6.4. The bisected individual is exposed to heat on the left and cold on the right. When it is necessary for the body to lose heat at a faster rate, there is increased perspiration, an increased breathing rate, vasodilation to permit more blood to come to the surface to be cooled, and decreased bodily activity. When it is necessary to conserve heat, there is a decreased breathing rate, vasoconstriction to keep the blood away from the surface of the body, increased general activity, and shivering. All of these reactions are regulated by the hypothalamus, which apparently has a center sensitive to the temperature of the blood flowing through it.

Since the automatic temperature controls can keep us comfortable within a fairly narrow range of external temperatures, we learn throughout our lives many patterns of behavior directly related to temperature motivation. In Figure 6.4 we see that a person who is too hot may seek

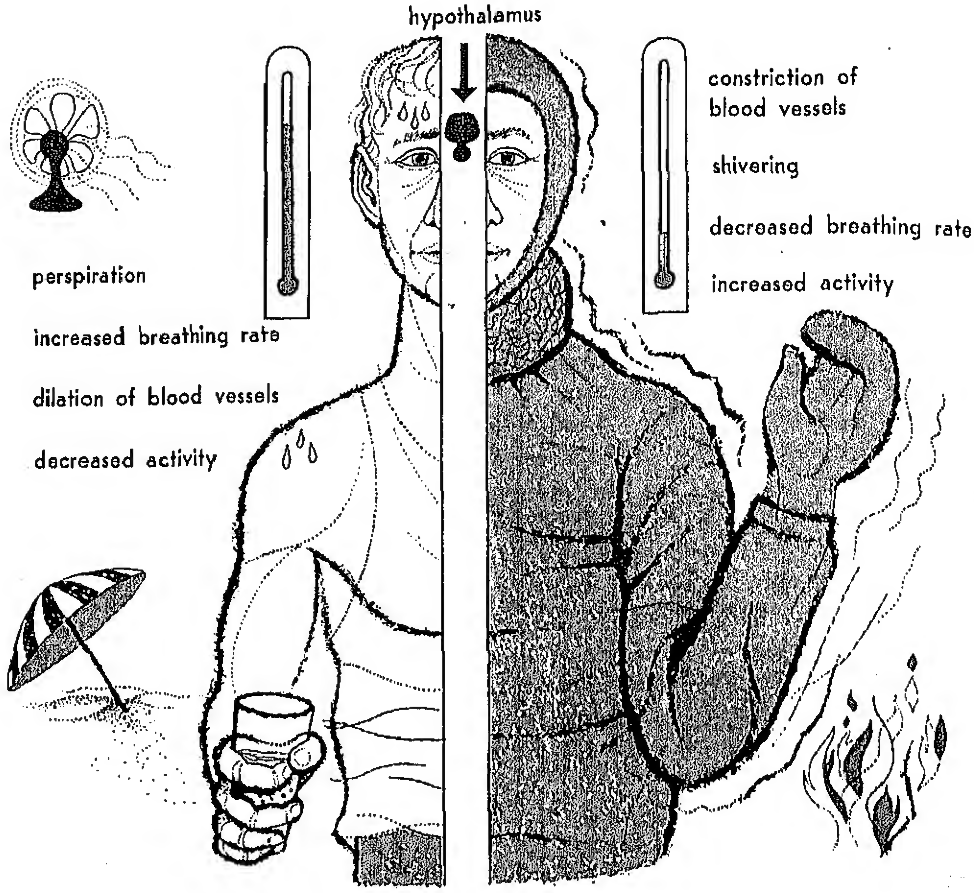


Figure 6.4. Temperature regulating activities. Both unlearned and learned activities help the body maintain its constant internal temperature. Some of the unlearned activities are listed in the figure, and some learned habits are pictured. Temperature regulation is controlled through the hypothalamus.

shade, cooling drinks, or an electric fan. One who is too cold wears warm clothing and seeks heat and shelter.

Man has learned to adapt to many climates and to many extremes of heat and cold, but there are limits to his capacity to endure either extreme. People living in the tropics, especially those with light skins, learn to avoid the midday sun. Even in the so-called temperate zones, many cases of heat prostration occur in any prolonged heat wave. When this happens, the continued exposure to extreme heat has resulted in a partial failure of the body's temperature control mechanisms, followed by the shock reactions of heat prostration. Since there are relatively few areas in the world where a naked, unsheltered, unheated human organism can survive throughout the year, man has evolved more complicated arrangements to protect himself from cold than from heat.

Clothing the body, which in prehistoric man was a mode of behavior directly related to temperature motivation, has come to be associated with many other motives. Ancient man found that clothes were useful in protecting the body against animals, against insects, against the damp ground, and against other hazards. As primitive cultures developed, special clothing was used to differentiate the various roles that individuals played in their group. Secular leaders and religious leaders were identi-

fied by their clothing, and still are today. Most cultures have developed different types of clothing for men and women. In addition, various articles of clothing, especially women's clothing, have taken on special meaning with respect to sex motivation.

The development of fads and fashions in clothing has meaning only in the framework of social behavior. Extremes in fads and fancies were developed in Europe in the seventeenth and eighteenth centuries, but are not unknown in any culture. We like to think that the modern trend is toward saner clothing that is both comfortable and efficient in preventing heat loss. Consider, for example, a midwestern coed on a January day. She goes about her business comfortably dressed in knee-length heavy socks and fleece-lined shoes. Yet that same evening she picks her way across the ice and snow in flimsy dancing slippers. Her escort is, of course, more sensible, save that his crew-cut top is innocent of cover. But six months later he manfully dons his tie and dinner jacket with the temperature near 80°. Our clothing habits at best represent a compromise of motives.

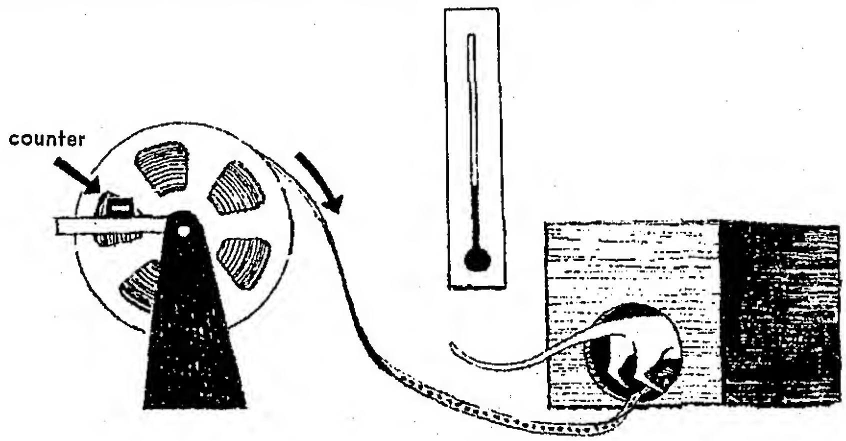
The designing and building of shelters is another example of a type of activity associated with a number of interrelated motives. Caves and crude huts originally served to keep men warm and to protect them from their enemies. Collections of huts became villages, and villages became cities, until the whole fabric of a civilization can now be represented in its magnificent buildings.

Lower animals show a number of complex patterns of activity related in part to temperature motivation. Many mammals hibernate during the winter months, during which time their normal body temperature is not maintained. Available evidence indicates that hibernation results from changes in glandular function as well as in external temperature. Food hoarding in some species also seems to be related to environmental temperature.[10] Laboratory rats hoard little or no food at normal room temperatures, but as the temperature gets lower they increase their hoarding activity proportionately.

Nest-building activity in animals can be compared to the use of shelters by man in the sense that it is related to several different motives. Although nest building is a part of mating and maternal behavior, it is also directly related to environmental temperature. In rats, it is possible to study nest building quantitatively by letting them have rolls of paper which turn a counter as they are unrolled. Figure 6.5 shows how a rat pulls paper tape into its cage to build a nest. Within limits it can be demonstrated that the colder the environment, the more paper the rat will use. At temperatures of around 40 to 50 degrees F., several hundred feet of paper may be pulled inside.

Sex. The expression of sexual motives in human adults covers a wide variety of

Figure 6.5. Temperature-controlled nesting behavior in the rat. Within limits, the amount of paper used by the rat in nesting was correlated with the coldness of the environment. (Based on Richter, C. P. Hypophyseal control of behavior. *Cold Spr. Harb. Sympos. quant. Biol.*, 1937, 5, 258–268.)



activities. There are not only the direct activities of courtship and mating, but also displaced sexual activities such as masturbation and homosexual behavior. Even less direct are the substitute or symbolic activities related to sex motivation that play such an important role in Freud's system of psychology. Unlike hunger and other physiological drives, sexual motivation is not directly related to the survival of the individual.

Development of the sex motive. Sexual behavior in adults is dependent upon both chemical and neural control. Of primary importance are the sex hormones secreted by the male and female sex organs, although secretions from other glands—notably the pituitary—also influence sexual activity. Specific patterns of sexual behavior are integrated by the nervous system.

There is an interesting evolutionary aspect to sexual behavior. Lower animals display more limited patterns of sexual expression, or mating behavior, and are more dependent upon the presence of the sex hormones in the blood for the activation of the behavior. The higher animals learn to react sexually to a much wider range of stimuli. Man, especially, shows great diversity in this respect. Along with their greater diversity in sexual excitability, the higher animals show less dependence on hormonal controls. A castrated human male, for example, may show little diminution of his sexual behavior for many years afterward.

Although full expression of sexual activity is not achieved until maturation of the sex organs, some forms can be observed even in infancy. According to Freudian theory, the sex motive is primary and prepotent throughout development. This view, however, is considered extreme today, even by modern advocates of Freud. Kinsey and his associates have attempted to trace memories of early sexual experiences by the interview method.[11] According to their information, many varieties of sexual expression, including the experience of the orgasm, can be found in infancy and childhood. Interest in sex is of course often observed in children, but probably is not based solely on sexual motivation.

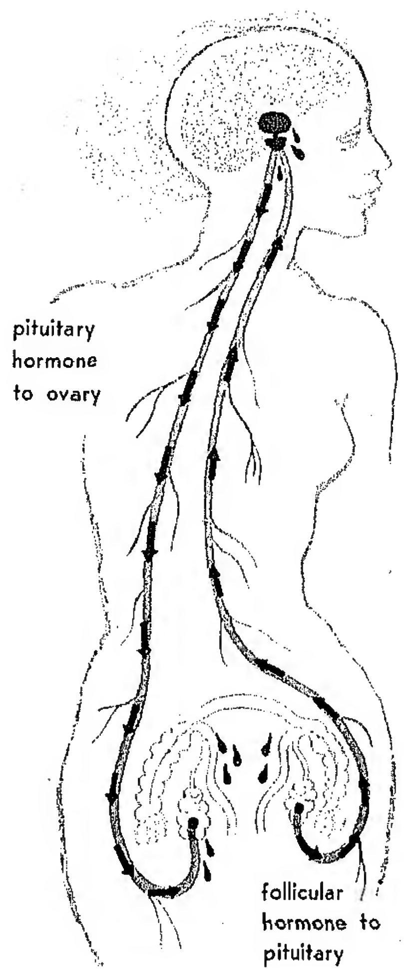
Whatever the nature of sexual behavior in childhood, it is obvious that true mating cannot occur until the sex organs have matured. If a physiological deficiency or castration prevents sexual maturity, the individual never displays the complete sexual behavior of the normal adult. We have noted above that castration in an adult may not greatly affect sexual activity, but early castration not only inhibits the development of the bodily sex characteristics but effectively cuts short the development of sexual behavior.

The female sex cycle. The primary characteristic of subhuman female sex behavior is its periodicity. In lower animals the female is receptive to the male when sex hormones are released into the bloodstream at the time of ovulation. This period is known as *estrus*, at which time we say the animal is "in heat." Even in the great apes, the receptivity of the female is periodically determined by hormonal conditions. In contrast, the sexually motivated behavior of the human female shows little or no periodicity, although there are certain behavioral changes which occur in connection with the human menstrual cycle.

Some of the complex interrelationships of the female sex cycle are indicated in Figure 6.6. A hormone from the anterior pituitary gland initiates the events of the cycle by stimulating the development of

ovarian follicles—clusters of cells containing the egg cells. As a follicle develops, it starts to secrete *estrogen,* one of the female sex hormones. Estrogen reacts on the pituitary and also causes changes in the lining of the uterus and vagina. Ovulation is the release of the egg cell by the rupturing of a mature follicle. While the egg travels to the uterus, the follicle changes into the *corpus luteum* under the influence of a second pituitary hormone, and secretes in addition to estrogen another hormone called *progesterone*, which is important in maintaining pregnancy. If fertilization of the egg does not occur, however, the corpus luteum regresses, with a consequent reduction in the amount of estrogen and progesterone. The lining of the uterus is sloughed off in menstruation and the pituitary hormone stimulates the growth of another follicle to start a new cycle. A menstrual cycle typically lasts about twenty-eight days. The time of ovulation is quite variable, but usually occurs twelve to fourteen days from the onset of menstruation.

What psychological changes can be correlated with the events of the sex cycle? We have noted above that in subhuman animals the receptivity of the female is very definitely a function of the cycle, reaching a peak just before and during ovulation. Human females show little if any change in sexual activity correlated with the cycle, but typically display more general psychological changes.[12] At the time of ovulation, a woman is usually more active and often experiences a feeling of elation. This general feeling of well-being is not prompted by her knowledge of the occurrence of ovulation, for in most cases she is not aware of this event. Toward the end of the menstrual cycle, a woman enters the



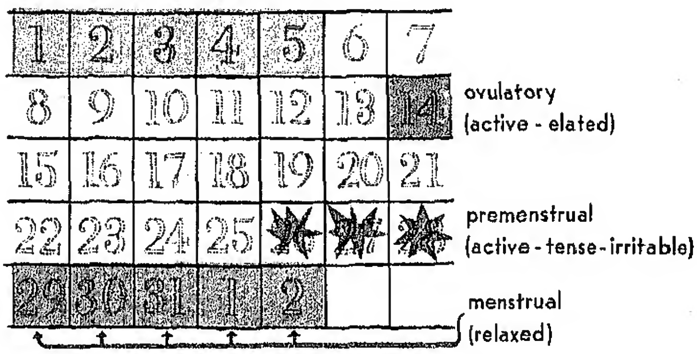


Figure 6.6. Physiological and behavioral events of the female sex cycle. Periodic physiological changes in the female sex cycle are correlated with changes in emotional behavior and activity level. In lower animals, female sex behavior is closely related to the hormonal cycle.

more widely recognized premenstrual phase, which is also characterized by increased activity, but in this case accompanied by tension. The general feeling is one of uneasiness, irritability, and sometimes depression. At the onset of menstruation, the woman relaxes and nervous tension decreases.

We should emphasize that these psychological changes cannot always be discerned, but occur frequently enough for us to consider them typical. The varying moods related to the female sex cycle can be dealt with more effectively and sensibly if their existence is recognized.

Male sexual behavior. The importance of the testes to normal physical and psychological development has been recognized since antiquity. In some ancient civilizations young boys were castrated in preparation for some types of service or slavery, and as a consequence did not develop the secondary sex characteristics, such as growth of body hair, change in voice, and so on. The arrested development of a young castrate, or eunuch, is due to the absence of the male sex hormones, the *androgens*, which are normally secreted by the male sex glands.

In addition to their effects on bodily development, the androgens are important in the motivation of male sexual behavior, although neural as well as chemical mechanisms are apparently involved. The sexual arousal of the male can occur from a wide variety of external stimuli, and it has sometimes been thought that the sex act is induced by local stimulation and/or mechanical pressure of the fluids of the testes upon sensory receptors in these organs. However, it is possible that the presence of androgens in the system is the primary factor underlying sexual motivation.

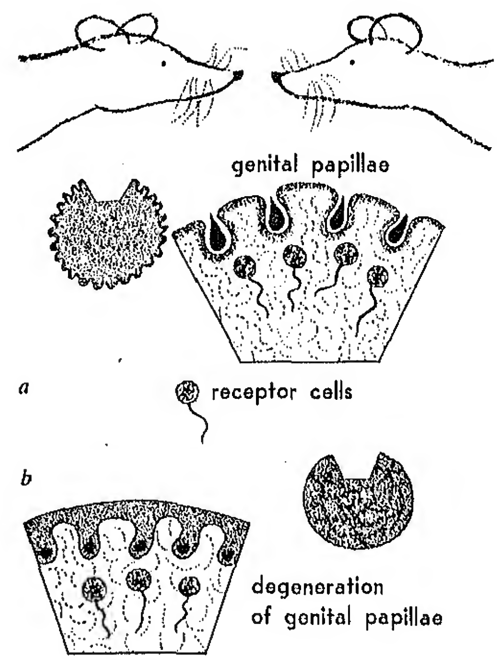
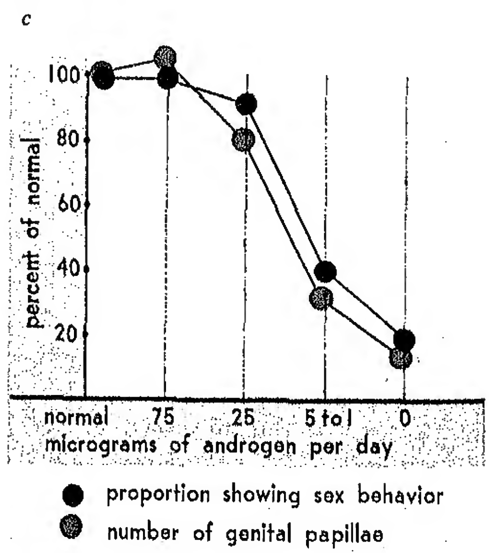


Figure 6.7. Behavioral and anatomical effects of androgen on castrated male rats. Sex behavior in male rats is related both to androgen and to androgen-maintained receptor structures. (Adapted from Beach, F. A., and Levinson, G. Effects of androgen on the glans penis and mating behavior of castrated male rats. *J. exp. Zool.*, 1950, **114**, 159–171.)



In an experiment on castrated rats, correlated changes in sexual behavior and anatomical changes affecting sensitivity were observed following castration. In the normal adult male rat, the glans penis (the rounded end of the penis) has an irregular folded surface with genital papillae in the depressions, directly over numerous touch corpuscles. Figure 6.7*a* shows a magnified cross section through the surface of the glans of a normal animal, showing the folds, papillae, and touch corpuscles. Following castration the glans becomes smooth and the papillae degenerate, as shown in Figure 6.7*b*. However, when testosterone (the principal male sex hormone) was administered to castrated rats in sufficient amounts, the changes in the glans did not occur. Rats which received inadequate doses showed changes in the glans proportionate to the amount of hormone they received.

Other groups of castrated rats were tested for frequency of copulation when put with females. Castration was followed by a gradual reduction in sexual behavior, but here, too, it was shown that the administering of testosterone in sufficient amounts prevented diminution in sexual activity. The remarkable similarity in anatomical and behavioral effects of castration followed by androgen treatment is shown in Figure 6.7*c*. Groups of rats receiving the largest daily dose of androgen showed no behavioral or anatomical loss, but the groups receiving smaller doses showed progressively greater losses in both anatomical and behavioral measures.

Casual inspection of these results might lead us to believe that the primary effects of androgen were anatomical and that mating behavior depended on the amount of sensory stimulation of the glans. However, other experiments indicate that androgen can affect behavior by acting directly on the central nervous system. For example, female rats treated with androgen show the mating response of the male. Here again we find that the hypothalamus is essential for the organization of motivated behavior, for limited hypothalamic lesions abolish mating behavior. This small area in the brain has an importance in behavior out of proportion to its size. We have seen that relatively specific activities connected with hunger, thirst, temperature control, and sexual behavior are regulated by centers in the hypothalamus, and our story of motivation is not yet complete.

Maternal Motives. One of the most forceful patterns of motivated behavior in the female individual is that of maternal behavior. A mother can be not only persistent, helpful, and self-sacrificing in her relations with her children, but a driving fury when it comes to protecting a child in danger. Although the specific responses involved in the care of human young are largely dependent on learning and cultural patterns, there is apparently a physiological drive state underlying the urge to have and to care for children. A common situation in any maternity home for unmarried mothers is the mother's persistent motivation to keep the infant, notwithstanding the social barriers that discourage the caring for an illegitimate child.

The drive states underlying maternal behavior are apparently related to the hormonal balances of the female sex cycle, pregnancy, and lactation. In subhuman animals, there are very specific patterns of maternal behavior which show little variation within a species. Female rats clean the newly born rat pups, and place them in a

nest that has been prepared. Nursing and caring for the young are related to complicated hormonal changes, including the secretion by the pituitary gland of *prolactin,* which stimulates the production of milk. When virgin female rats are injected with prolactin, they will care for a litter of rat pups in much the same way as the natural mother cares for them.[13] This response is similar to that of the male rat described in Chapter 4 which responded with maternal behavior when injected with a female sex hormone in the hypothalamus.

Sleep. A tired individual is strongly motivated to rest or sleep. We often think of rest and sleep as being similar activities, but actually they are quite different. Resting—a state of reduced activity—may be indulged in at almost any time of day or night. Sleep, on the other hand, is a definite physiological state that does not necessarily occur in relation to fatigue. We may be most fatigued at various times during our working day, but sleep comes most easily at our normal bedtime, even though we have been resting for several hours.

There are well-defined bodily changes correlated with periods of waking and sleeping. Body temperature shows a regular daily rhythm, with a peak occurring during waking hours and a low point during sleep. The electrical activity of the brain, as recorded in brain waves, shows different patterns during waking and sleeping. As we saw in Chapter 4, the hypothalamus is involved in the regulation of sleeping and waking. Injuries in one area of the hypothalamus result in persisting sleeplike states, while injuries in another region result in an apparent inability to sleep. However, other neural mechanisms are involved as well. You will remember that the activation pattern of the cortex, reflecting a heightened activity level, is maintained by sensory stimulation over the afferent pathways to the brain.

Development of sleep patterns. The most striking aspect of sleep motivation is its persistent rhythm. Once a sleep pattern has been established it is extremely difficult to change it, although it may be disturbed temporarily. We all adjust our waking and sleeping primarily to the alternate periods of day and night in our twenty-four-hour day. A newborn infant in the first days or even weeks of his life does not respect the difference between day and night. He sleeps most of the time at first, alternating periods of sleep with shorter periods of wakefulness every three to four hours, when hunger takes over. In a relatively short time, he is sleeping for longer periods at night and shorter periods during the day. He takes two daytime naps at the age of one, later one daytime nap. By the time he is four or five he has adopted the adult pattern of one sleep period during the twenty-four hours.

Kleitman has carried out a number of experiments on the nature of sleep rhythms.[14] In one experiment he and one of his students attempted to adjust to a

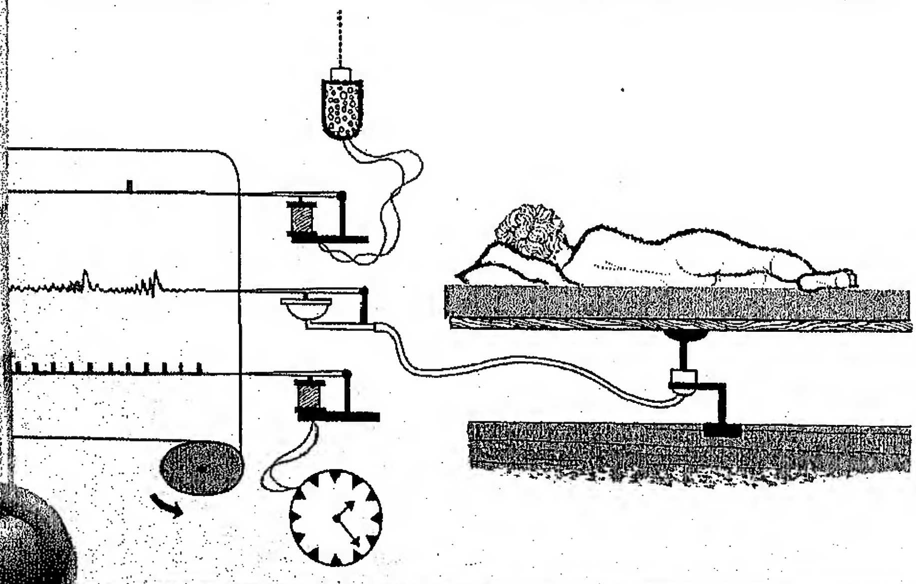


Figure 6.8. Recording activity during sleep. A sleep recorder demonstrates that the average sleeper changes his position 30 to 50 times during the night, even though he is sleeping soundly. External stimulation may cause activity without wakening the sleeper.

twenty-eight-hour day by living for a month in Mammoth Cave, where the temperature is constant and there is no light or noise. One of the men adjusted successfully within the month to the longer day, but the other did not.

Effects of sleep loss. The stress of prolonged loss of sleep, like the stresses connected with extreme hunger and extreme thirst, produces marked psychological as well as physiological effects. Seventeen college students who went for one hundred hours without sleep showed irritability, headaches, loss of attention, hallucinations, and desire for isolation.[15] Their ability to read deteriorated, and they found it necessary to exert increased effort to carry out simple tasks. Other studies have shown that even limited sleep loss results in a general slowing down of bodily movements, although fine manipulative movements are not affected as soon.[16] Precision in visual pursuit movements is reduced by loss of sleep of over one night's duration, even when subjects attempt to maintain their normal level of performance.

Studies of the effects of sleep loss are important in relation to the understanding and control of factors influencing performance and safety in human work. When precise activity, optimal motivation, and high-speed response are demanded in human performance, even limited sleep loss should be avoided. Most of the sleep-loss studies have used as subjects young college students who are at the age of peak ability in withstanding sleep loss; even these young people showed emotional, perceptual, and motor changes beginning during the first night's loss of sleep.

Sleep motility and dreaming. Even a deep sleep is not free of bodily activity. In addition to the activity of dreaming, which is often recalled after awakening, the sleeper shows intermittent bodily activity all night long, even though he thinks that he "slept like a log."[17] Motility during sleep can be measured by a sleep recorder, such as the one shown in Figure 6.8. An air-pressure recorder attached to the springs of a bed can transmit movements of the sleeper to a recording marker. The ordinary sleeper changes his position on the average of once every 11.5 minutes during the night, making thirty to fifty changes. Most sleepers show greater activity toward morning than in the early part of the sleep period, although there are many individual variations in activity patterns. Many specific factors, such as temperature, the seasons, motion-picture viewing, emotional disturbance, hunger, thirst, and other states of motivation, affect the sleep of both children and adults. These influences are not consistent in their effects on different individuals. For example, motion-picture viewing increases sleep activity of some children and decreases it for others.

Because dreams represent a partial interruption of the sleep patterns, their interpretation is of interest in relation to the subject of sleep motivation. We have already discussed Freud's sexual symbolism theory of dreams. It seems more reasonable, however, to think of dreams as representing activity brought about by any insistent motive, not just the sexual motive. Subjects in starvation studies dream very frequently of food, while subjects in thirst experiments dream of water far more frequently than they do normally. Dreams are often instigated by the effects of cold, or from overeating. The nightmare is an emotional outburst brought on by the stress of anxiety and may reproduce the events of some harrowing experience. Dreams

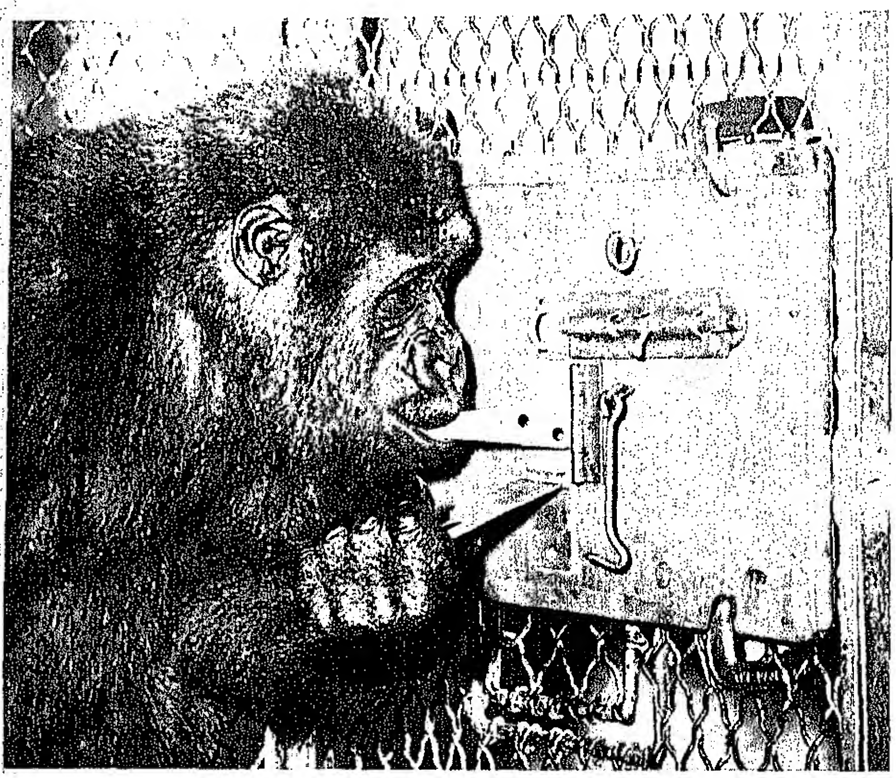


Figure 6.9. Activity motivation in the gorilla. The animal is learning to put together a complicated puzzle with no other reward than the activity itself. (Courtesy the San Diego Zoo.)

represent the interruption of the sleep pattern by other forms of persisting motivated behavior.

GENERAL MOTIVES

The specific motives described thus far are related to definite physiological states, and the resulting motivated activity is directed toward fairly specific goals or incentives. In each of these drive states (with the possible exceptions of sexual and maternal behavior) we can apply the principle of homeostasis, showing that the goal sought tends to bring the organism back into a state of equilibrium. There are, however, other kinds of motivated behavior that seem to have little to do with homeostasis. If man's only goals were to maintain himself in a balanced state, much of the zest would be gone from human behavior. "Man shall not live by bread alone," has psychological as well as moral truth.

Many patterns of activity, both learned and unlearned, are based on general motives, those persistent conditions unrelated to specific physiological needs or functions. We find familiar examples of such general motivation in the sustained activities of play and recreation, reading for pleasure, listening to music or appreciating visual forms of art, and watching theatrical productions or sports activities. Our patterns of adjustment and psychological welfare are as critically related to the satisfaction of general motives as to our ability to satisfy hunger, thirst, or sex needs.

The general motives described below are *important forces in human behavior.* In addition to activity and perceptual motivation, all emotional activities can be described as general motives—from the anxiety of frustration to the need for love and affection.

Activity Motivation. Activity motivation has been known by a variety of names, such as spontaneous activity and exploratory drive. What we are dealing with here are the generalized movements of the playful animal or child, the restless motions of the caged beast—in short, that kind of activity that has as its goal movement itself. The gorilla in Figure 6.9 is learning to put together a very complicated puzzle with no other reward or goal involved save the activity itself. Its task is to manipulate, in proper sequence, a bolt, a hook, and a couple of hinges so that everything fits together neatly. The completion of the pattern of activity contains its own intrinsic

reward. Play activities of children and adults are similarly self-rewarding.

Modern handling of surgical and maternity cases illustrates very well the role of bodily activity in maintaining psychological as well as physiological well-being. Up to a few years ago it was standard practice to confine surgical and maternity cases to periods of bed rest lasting days or even weeks. Now most such cases are gotten out of bed on the first or second day following operation or delivery. Patients treated in this way recover faster and their period of convalescence is shorter.

Severe restriction of activity has serious psychological effects. Twenty-two young men were paid to lie on a comfortable bed, as shown in Figure 6.10, in a lighted, sound-resistant cubicle for twenty-four hours a day with time out only for eating and toilet needs. Sensory stimulation was held to a minimum. The subjects wore goggles fitted with translucent glass, gloves, and cardboard cuffs over their forearms and hands to reduce movement and stimulation of the hands. Auditory stimulation consisted of little more than a continual hum from the ventilating fans. The subjects, even though paid twenty dollars per day, would not continue the experiment for more than two or three days.

The general psychological effects of the activity frustration are illustrated by the three faces in Figure 6.10. The subjects experienced distortion of time and space. Space appeared to be two-dimensional when they were removed from the cubicle. Several of the subjects felt as if there were two bodies lying in the cubicle, or as if their heads and bodies were detached. The subjects showed disturbances in thinking; they could not concentrate on anything for long, and made poor scores on problems given them in isolation. On leaving the cubicle they showed reduced performance on thinking tests such as the digit-symbol substitution test in the figure. Quite complex visual hallucinations occurred, ranging from geometric patterns to integrated scenes of dreamlike quality. Several subjects also reported auditory and kinesthetic hallucinations. During the first day of isolation the subjects were elated, but thereafter they became irritable.

In another study, an experimenter lay face down in a tank of warm water, wearing a skin diver's mask for breathing, and tried to keep perfectly still.[18] For about forty-five minutes, he found the experience rather pleasant, but then followed a period of almost unbearable tension. He found himself making small movements just to be doing something. The period of tension was followed by a period of highly emotional fantasy, and that in turn was followed by

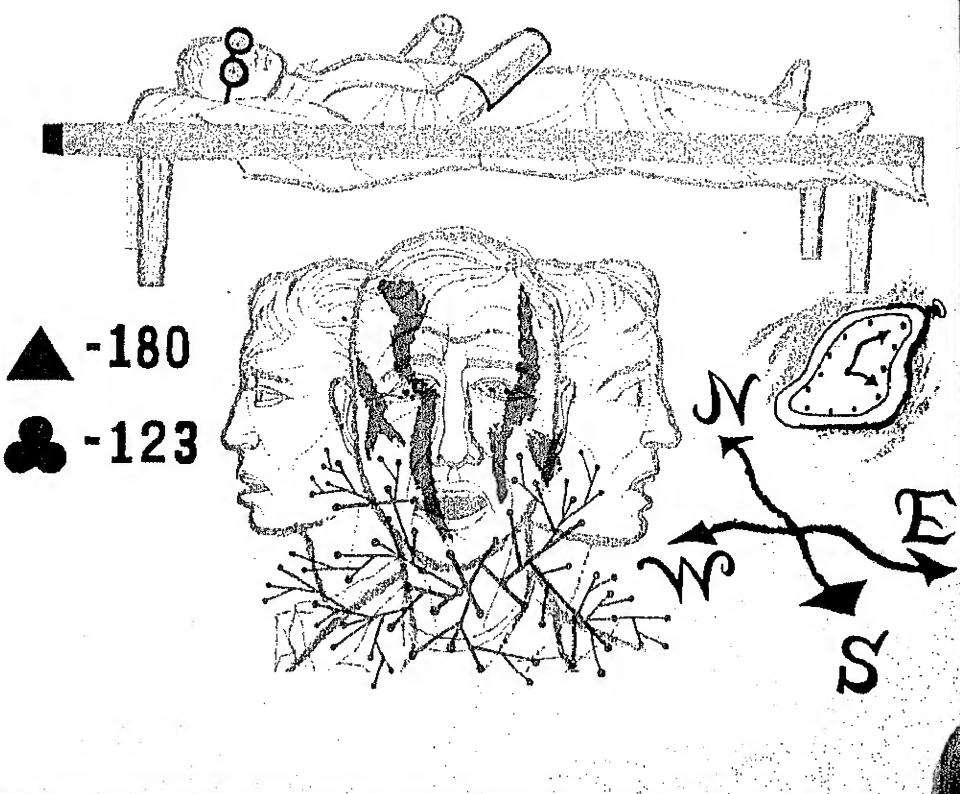
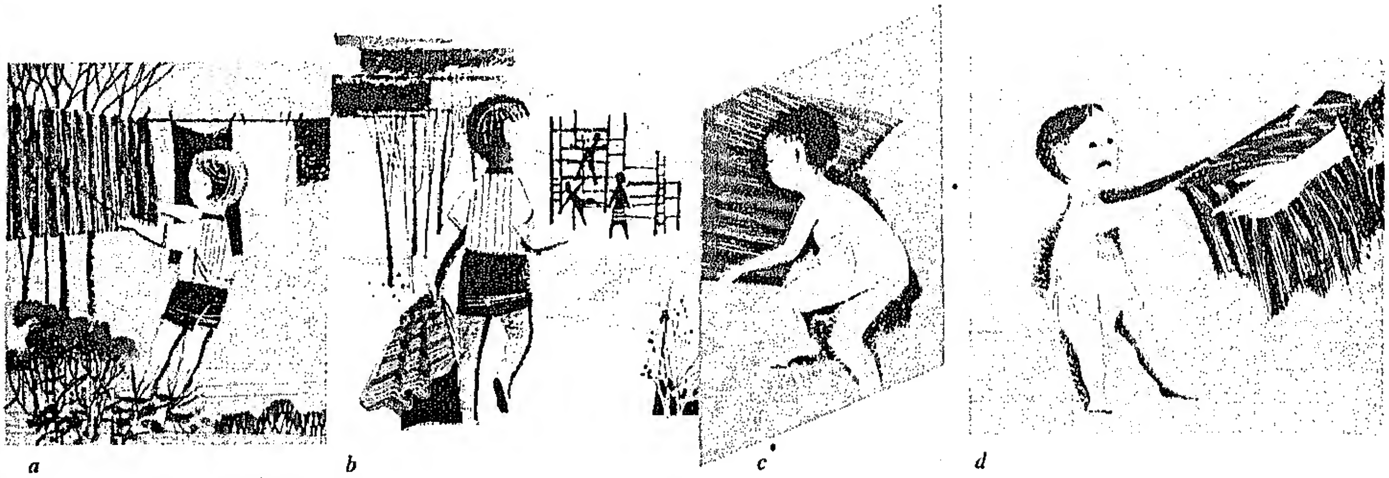


Figure 6.10. Effects of gross restriction of activity. Subjects experimentally restricted in activity and stimulation showed marked psychological effects. They experienced distortions of time and space, reported marked hallucinations, and made poor scores on thinking tests after their isolation. (Based on Bexton, W. H., Heron, W., and Scott, T. H. Effects of decreased variation in the sensory environment. *Canad. J. Psychol.*, 1954, 8, 70–76.)



a b c d

Figure 6.11. Emotional-perceptual motivation in a child. Many activities are sustained by the motivational aspects of perception. The child becomes attached to the blanket as a perceptual object and is emotionally—as well as perceptually—motivated to retain it.

a phase of marked visual hallucinations.

These experiments can be interpreted as showing the effects of gross restriction of both overt and perceptual activities. The effects were almost as marked as those occurring in extreme food or water restriction. In fact, the psychological disturbances observed in semistarvation might well be due to the reduced activity level, rather than from food deprivation as such.

Some of the same psychological effects have been observed in "stir-crazy" convicts, particularly those coming out of solitary confinement. They sometimes are disoriented in time, show "fuzzy" thinking, and give evidence of marked emotional disturbance. The restriction studies raise serious questions as to the advisability of close confinement as a method of treating either criminals or disturbed patients.

Perceptual Motivation. Many young children become attached to objects, especially fuzzy objects, which they are accustomed to take to bed with them. A child may want a soft, furry animal toy in his bed, or a woolly blanket, or a pillow. It is not unusual for a child to keep a particular object with him throughout most of the twenty-four hours. Figure 6.11 shows a child who is attached to a blanket as a perceptual object. He cannot stand to be separated from the blanket. When it is washed and hung out to dry, he seeks it and cries for it (*a*). When he gets it, he drags it around with him throughout the day (*b*). When the child gets tired and sleepy, he clutches it, rubs it, and cuddles it while going to sleep (*c*). The real strength of this motivation is seen when his mother decides that the dirty thing should be thrown away (*d*). He manages to keep the blanket until it is reduced by time and wear to small remnants of wool.

This attachment to the blanket is emotional in character, but it seems also to be the type of behavior we describe as being perceptually motivated. All of our motives are complicated by appetites and aversions. We seek out objects and stimulating situations that are pleasant to us and try to avoid those that are unpleasant. Although some likes and dislikes are very individual matters, apparently resulting from specific

learning situations, others are almost universal. Almost all children prefer bright colors to neutral shades. Most people like to feel certain kinds of surfaces—velvet or smoothly carved wood. There are odors seemingly pleasing to everyone, and others that are repugnant without exception. Perceptual motives often influence interpersonal behavior; body odor and bad breath were not invented by an adman, but operate effectively in perceptual motivation, especially in the relations between men and women.

The appreciation of music and visual art forms can be understood as perceptual motivation. Forms of esthetic behavior go back into the dim past of Stone Age man, who drew pictures in caves for his own perceptual satisfaction. The science of esthetics has quantified many aspects of the strengths and values in perceptual motivation.

One of our criteria of motivation is whether it activates the organism enough to bring about new learning. We shall deal with the relationship between learning and goal seeking in more detail in Chapter 10. For the moment, we want to point out that animals learn new responses on the basis of perceptual motives. One of the first experiments demonstrating perceptual learning in animals is illustrated in Figure 6.12. A well-fed monkey was placed inside a large lighted box with two doors that opened outward (*a*). The doors were marked with blue and yellow stimulus cards which were changed back and forth in random order. One color was always

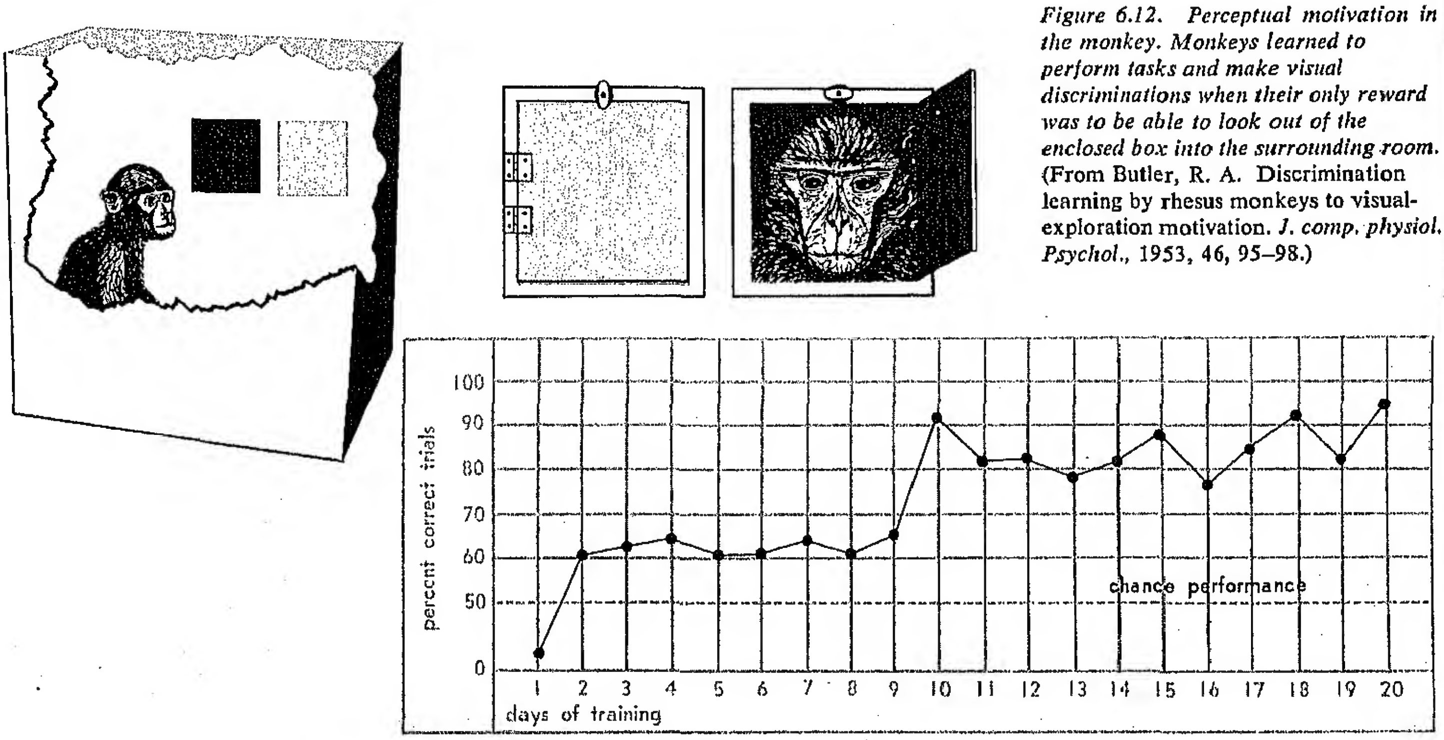
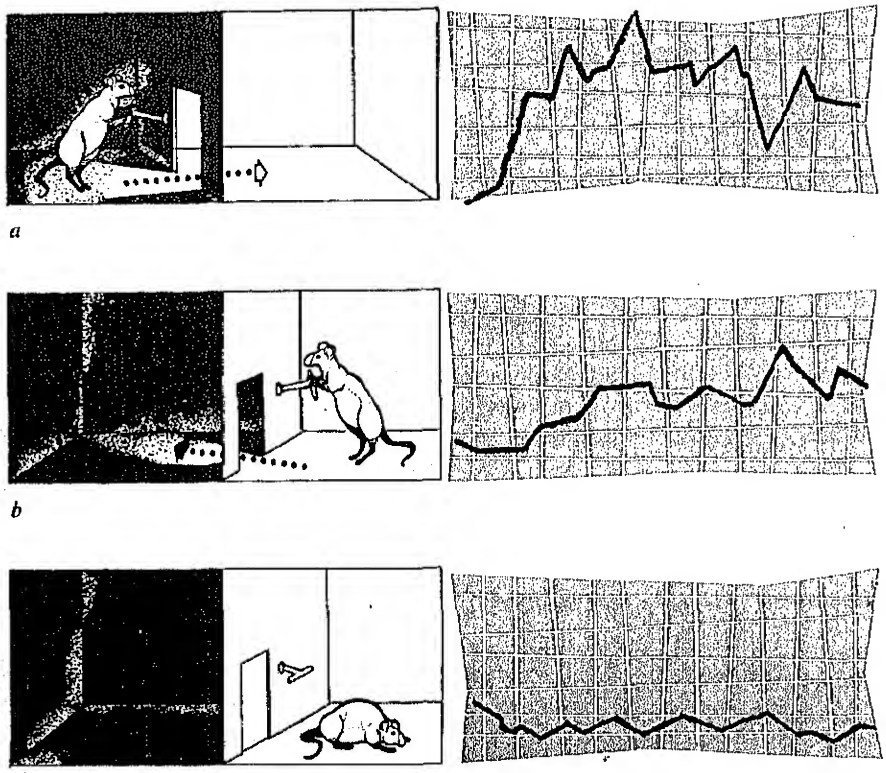


Figure 6.12. Perceptual motivation in the monkey. Monkeys learned to perform tasks and make visual discriminations when their only reward was to be able to look out of the enclosed box into the surrounding room. (From Butler, R. A. Discrimination learning by rhesus monkeys to visual-exploration motivation. *J. comp. physiol. Psychol.*, 1953, 46, 95–98.)



a b c

Figure 6.13. Learning motivated by "exploration." Rats neither hungry nor thirsty learned to press a bar to escape from a black room into a white, a, *learned it less rapidly to escape from white into black,* b, *and did not learn the habit if the panel blocked their way,* c. (Adapted from Myers, A. K., and Miller, N. E. Failure to find a learned drive based on hunger; evidence for learning motivated by "exploration." *J. comp. physiol. Psychol.*, 1954, 47, 428–436.)

positive—that is, it indicated an unlocked door—while the other was always negative, indicating a locked door. When the animal made a correct response of opening the door marked with the dark card, he got his "visual" reward (*b*). He could look out into the laboratory. Figure 6.12*c* shows a learning curve for three monkeys for the discrimination habit based on a perceptual reward.

Even rats learn habits based on perceptual rewards. In Figure 6.13*a*, a rat is learning to press a bar that opens the door into the next compartment. The learning curve superimposed shows how rapidly ten rats acquired this habit when they were placed in a black compartment first and pressed the bar to get into a white compartment. If rats were placed in the white compartment first, as in Figure 6.13*b*, they learned the bar-pressing habit, but not as rapidly as the first group. Apparently, rats are more strongly motivated to go into a white room from a black room than into a black room from a white one. For a control group of ten rats (Fig. 6.13*c*), a panel was placed immediately behind the door, so that when the door opened the rat could neither see nor enter the other compartment. The superimposed curve shows that no learning occurred.

Experiments such as these on perceptually motivated behavior are changing our thinking about the nature of goals in learning. They indicate the very great importance of varied environmental stimulation and perceptual organization in habit formation. Perceptual events and activities unrelated to physiological drives are rewarding enough in themselves to bring about learning.

LEARNING AND MOTIVATION

The basic physiological states that motivate behavior are not learned; they are a part of the individual's organic make-up. The needs of the body for food, water, oxygen, sleep, and the like, as well as its more general needs for activity and emotional and perceptual satisfaction, do not depend on behavioral experience. To a limited degree our motivated activity also is unlearned—our breathing and automatic temperature controls, for example. For the most part, however, the *means* by which an individual satisfies his needs are learned behavior patterns.

Hunger is a physiological need, but we

learn to satisfy it in many ways and with a wide variety of foods. Thirst is a very specific need, but it, too, becomes modified by learning. On a hot summer afternoon a thirsty child wants a soda, a thirsty teenager yearns for a Coke, while a thirsty adult may open a can of beer. By learning, we change the nature of our incentives or goals and also organize the intermediate activity by means of which we reach our goals. Getting a drink of water is a very different process in a primitive child who drinks from a running stream and a city child who turns a water tap. Figure 6.14 shows that rats, too, can be quite adaptable in satisfying their needs. This rat has learned to get a drink by the "old oaken bucket" technique.

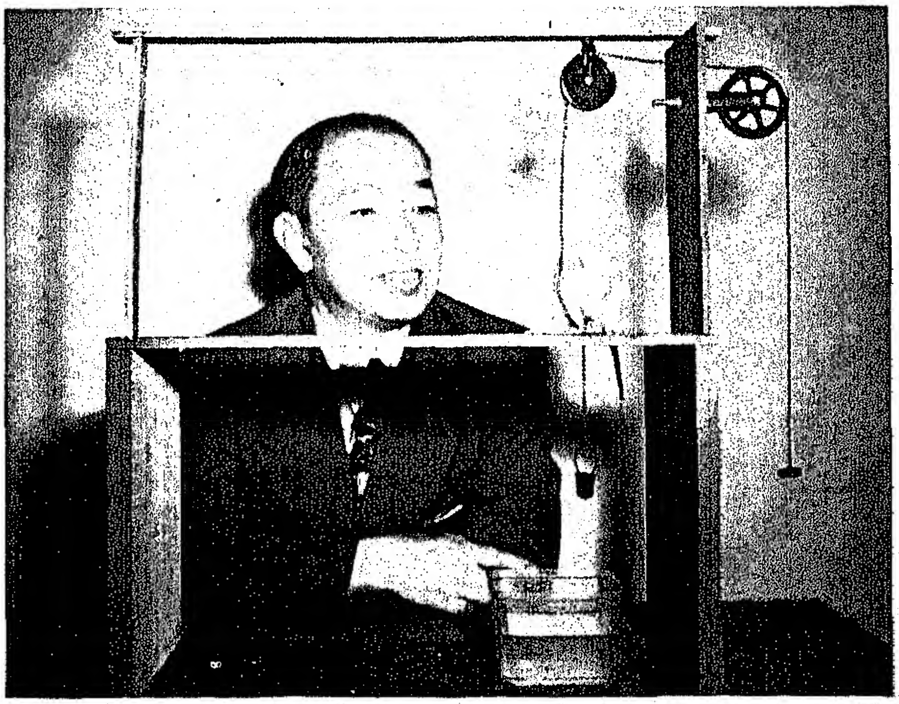
Instinctive Behavior Patterns. Some quite complicated patterns of motivated activity in lower animals unfold under the proper conditions without the need for prior learning. These are the activities often referred to as "instinctive." Many of the migratory patterns of which we spoke in Chapter 4 are such unlearned mechanisms of response. So also are some of the maternal activities of animals—nest building and care of the young. We have seen that maternal patterns can be elicited in male rats or virgin female rats when such rats are stimulated with hormonal injections.

The term, instinct, is often used very loosely to describe everything from simple reflexes to highly organized patterns of social behavior (e.g., herd instinct). If we use the term at all, we must remember that it is descriptive only, and does not explain the behavior that it describes. The newly hatched loggerhead turtle marches to the sea not because of a "sea-seeking instinct," but because of an unlearned response pattern which causes it to react positively to the gleam of light on the surf.

The human individual displays no complex unlearned patterns of motivated behavior that can be called instinctive. Aside from the few reflexes that characterize his motivated behavior at birth—breathing, sucking, crying—all of his motivated behavior must be learned.

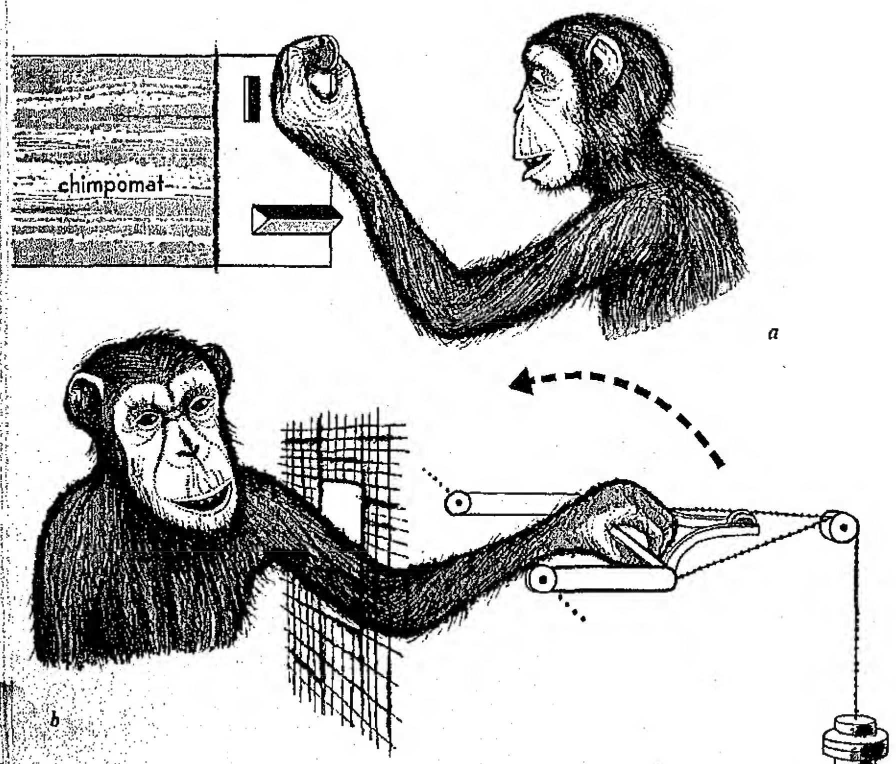
Secondary Goals. The most striking thing about human motivation is that the things we strive for—our incentives and goals—often seem to have nothing to do with our basic needs. We want money, prestige, political power, good grades, a newer car. We call these *secondary goals,* because they do not satisfy a primary physiological need. How do we acquire motives directed toward secondary goals?

Figure 6.14. Thirst satisfied by learned activity. Even in lower animals, many specific physiological motives are satisfied by learned behavior patterns. (Courtesy Dr. Loh Seng Tsai.)



The setting up of secondary goals can be demonstrated clearly in animals. For example, Figure 6.15 illustrates how a chimpanzee can be trained to attach value to a poker chip. Young chimpanzees were first taught to use poker chips in a type of vending machine in order to receive a food reward. The next step was to teach them to discriminate among poker chips of different colors. All of the subjects learned that a white token could be used to get a grape, whereas a brass token was valueless. Later they learned to prefer a blue token over a white because the blue one could be exchanged for two grapes. Some of the subjects learned to exchange tokens of specific colors for water when they were thirsty and for certain activity privileges—being allowed either to return to the home cage or to play with the experimenter.

Figure 6.15. Derived motives in chimpanzees. Chimpanzees worked for poker chip tokens, b, *once they had learned that the tokens could be exchanged for food,* a. (Adapted from Wolfe, J. B. Effectiveness of token-rewards for chimpanzees. *Comp. Psychol. Monogr.*, 1936, **12**, No. 60.)



So far, the chimpanzees were simply using the tokens as a means of satisfying primary needs, much as the rat in Figure 6.14 used a bucket to haul up a drink of water. The next question was whether the chimpanzees would work and learn new habits when the only rewards were the poker-chip tokens. Figure 6.15*b* shows a chimpanzee operating a work-machine to obtain a token reward. After the animals had learned the value of the tokens, they worked about as hard to obtain them as to obtain food directly. They also learned to work cooperatively for tokens and to solve problems to get them. In these reactions we see a very elementary type of economic behavior consisting of exchange of goods through the use of arbitrary tokens.

There are many other studies showing how secondary goals can be established in animals. Rats which were given food in a white box but not in a black box learned to prefer white boxes over black.[19] However, we saw in Chapter 3 that rats can learn to fear a white box when they receive electric shocks in it.[20] To a rat, the value of a white box may be positive if it has been associated with a primary goal such as food, or it may be negative if it has been associated with pain. But before the rat has had experience with a white box, it is just another place to explore.

Functional Autonomy of Motives. Once secondary motives have become established, do they continue to function independently of the basic drives with which they were originally associated? That is, would the chimpanzees continue to value poker chips even if these tokens could no longer be exchanged for primary goals?

In human behavior it has been postulated that secondary motives acquire a functional autonomy by means of which they become independent of physiological drives.[21] Thus the money which originally was valued because it could be exchanged for primary goals becomes an end in itself. Our clothing and houses are valued for themselves, not just because they help to keep us warm.

On the other hand, we cannot describe secondary motives as solely autonomous if we realize how they are tied up with the emotional life of the individual. Any activity that satisfies an emotional need or relieves anxiety is tied to a physiological drive state as much as if it satisfied hunger, or thirst, or sexual need. The rat that valued a white box because of its association with food might forget that value if food were no longer forthcoming. But the rat that feared a white box was motivated to avoid it even when the shock was no longer present (see Fig. 3.14). Anxiety is a powerful and persisting motive. Furthermore, our descriptions of activity and perceptual motives indicate that these, too, are unlearned needs and can motivate the individual to learn and retain many kinds of behavior patterns. The many goals for which the human individual strives, the many social motives that direct his activity, are never divorced from the motivational-emotional state of the organism.

Social Motives. Most of the needs of the human baby are satisfied through social means. Whenever he is hungry or thirsty or uncomfortable, the resulting activity involves another person—usually the mother. Soon the mother comes to be a secondary goal. She not only helps to satisfy specific drives, but also comforts the child, soothes him, and helps relieve his pains. As the child grows older, most of his drive states continue to be associated with other people—especially his general emotional states and perceptual needs.

As a result of this early learning, individuals have many needs which can be satisfied only in a social situation. Social psychologists have sometimes attempted to list these needs and classify them. Affiliative needs describe the individual's tendency to identify himself with other persons or with a social group. We are strongly motivated to find approval and companionship among family or friends. We find security in these associations. Related to this need is the need for a companion to satisfy the sex drive.

Other social motives are related to the individual's need to achieve personal power, prestige, or status in his group. The achievement needs or status needs are obviously much stronger in some people than in others. We all know people whose principal aim in life is to achieve recognition and power in social, economic, political, or other groups. Very often, social motives are related to the anxieties of frustration, and persist because of their emotional origin. In fact, our social motives are generally based on emotional states, and function either to provide emotional satisfactions or to relieve tension and anxiety. We shall learn more about the relation of social motives to group behavior in Chapter 14.

Economic Motivation. The science of human motivation has some direct implications for economic theories of our social structure. Our own national economy is based on the persisting motivation of millions of workers to stay on the job forty hours or more every week. What keeps

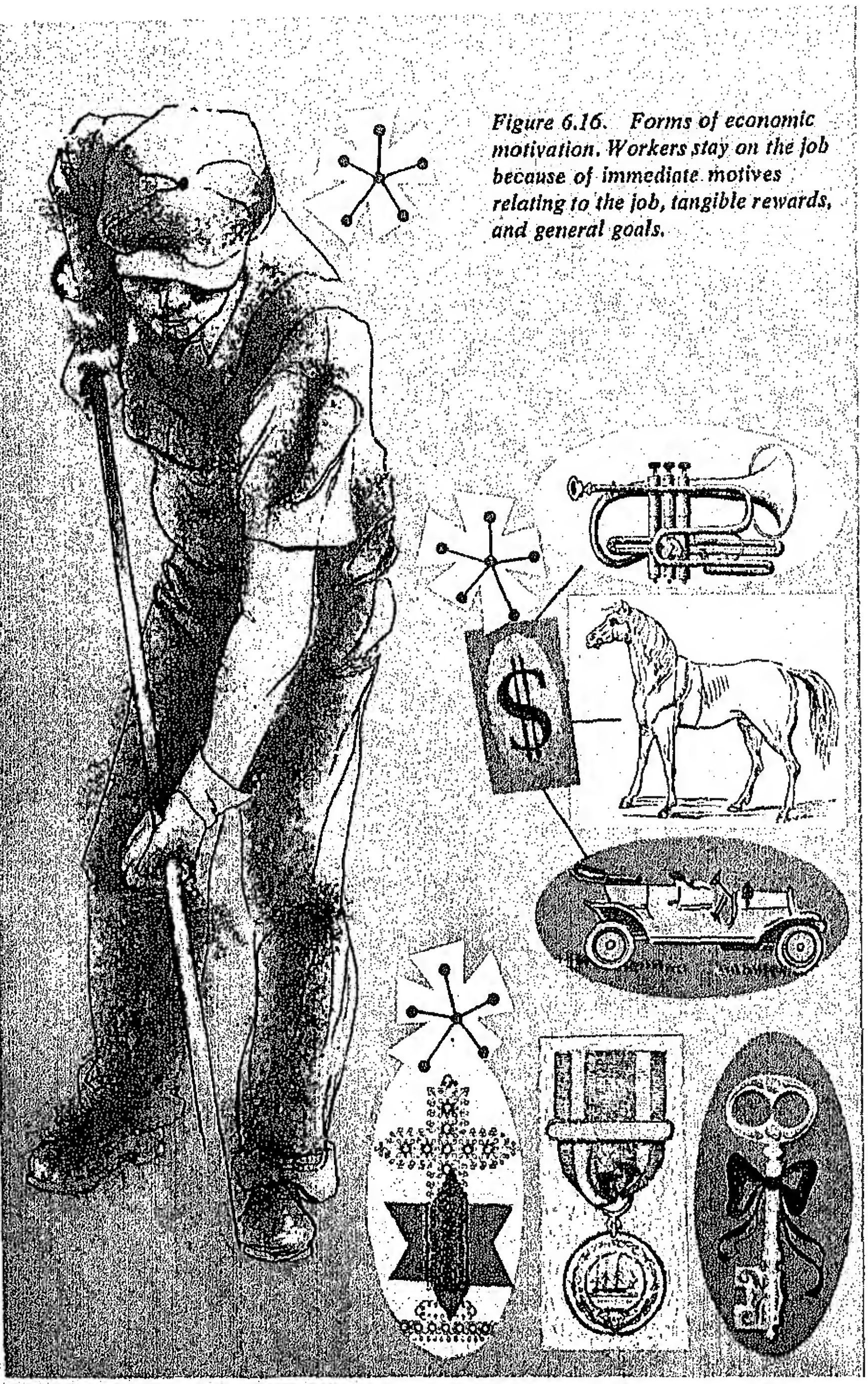


Figure 6.16. Forms of economic motivation. Workers stay on the job because of immediate motives relating to the job, tangible rewards, and general goals.

them all at work? In an economy of plenty, their basic physiological needs are usually easily satisfied; time and effort can be put toward acquiring cars, clothes, television, vacation trips, college educations, and so on. Traditional economic theories have emphasized the importance of financial incentives and other tangible goals in keeping workers on the job, but actually there are other motives fully as important to some workers as their pay.

A worker on the job is influenced by at least three types of motives, as shown in Figure 6.16. In the first place, most workers get a certain amount of satisfaction out of doing their jobs, although this factor varies tremendously from worker to worker. The motivation to do one's job—any job—may often be related to activity and perceptual motivation. There are other immediate motives related to general working conditions and the social setting in which the work is done, all of which are related to the extent to which the job situation is fitted to the man. A second class of motives has to do with the tangible work rewards, which satisfy both specific and general physiological needs. The third type is related to general values and goals of a society or culture. For example, the economic motivation of a preacher or religious leader is defined in large part by the general motives relating to his beliefs. A teacher sticks to the job of teaching partly because of his general ideals. A labor union official is not so much interested in his day-to-day routine as in the long-range goals of his group.

Most individuals are undoubtedly influenced by all three types of motives at one time or another, but even in the same person the emphasis changes. We can think of the immediate motives as being strongest

in the person who loves his work beyond any secondary consideration. A creative artist goes on producing often in spite of, rather than because of, the nature of his tangible rewards. Men who try to retire often find that satisfaction in life depends on a return to their jobs. Many workers obviously find their strongest economic motivation in the tangible rewards they receive; for example, steel workers or miners will tolerate dramatic hazards for extra compensation. Finally, there are those who find their greatest job satisfactions in the realm of general goals and ideals. We have already mentioned preachers, teachers, and labor union leaders. Many workers in government also fall in this category. During critical times the dollar-a-year man in Washington, who often gives up a highly paid position, is a case in point.

Understanding human motivation to do one's work well is important in business and industry from the standpoint of efficiency and productivity. A study carried out in a large insurance company tried to determine the motivating factors operating to effect high production among clerical workers. Twelve high-producing and twelve low-producing sections of the company were chosen for the study because they could be matched in terms of the number of workers in the group, the age of the workers, and the type of work done. Thus, each pair of work groups, as shown in Figure 6.17, were matched except in the significant difference that existed between them in productivity.

The workers in all of these groups were interviewed to determine what they thought about their supervisors. As shown in Figure 6.17, the high producers and low producers differed significantly in their attitudes. Eleven out of the twelve high-producing groups thought their supervisors were democratic and reasonable, while none of these groups thought their supervisors were authoritarian. Of the low producers, four groups rated their supervisors as democratic, seven as reasonable, while eight groups thought their supervisors were authoritarian.

This study shows that motivation to work is significantly affected by the nature of interpersonal relations in the work situation. It also introduces us to the study of attitudes and how these emotionally based habits of thinking influence overt behavior. We shall return to some of the problems of attitudes and beliefs in Chapter 12.

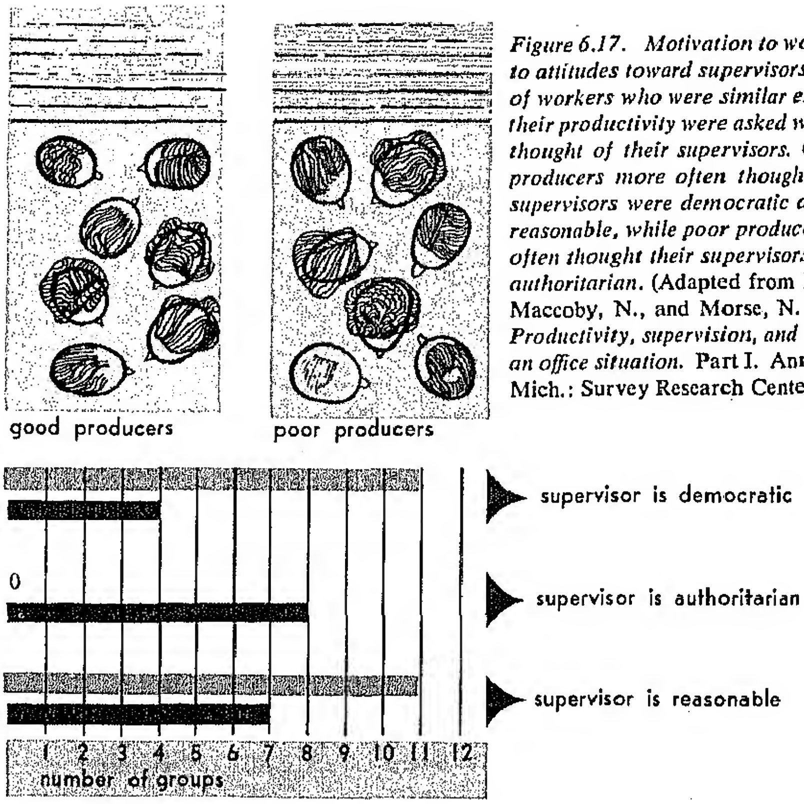


Figure 6.17. Motivation to work related to attitudes toward supervisors. Groups of workers who were similar except in their productivity were asked what they thought of their supervisors. Good producers more often thought their supervisors were democratic and reasonable, while poor producers more often thought their supervisors authoritarian. (Adapted from Katz, D., Maccoby, N., and Morse, N. C. *Productivity, supervision, and morale in an office situation.* Part I. Ann Arbor, Mich.: Survey Research Center, 1950.)

SUMMARY

Motivation—the dynamic aspect of behavior—has three characteristics: (1) the drive condition, (2) the motivated activity, and (3) the incentive or goal. At any given time, motivated behavior results from the combined effects of different drive conditions acting on the individual.

Most specific motives are homeostatic; that is, they tend to maintain the organism at a steady internal state. Neural, chemical, and both unlearned and learned sensory-motor mechanisms are integrated to achieve these balances.

Hunger is a complex pattern made up of general and partial hungers. Neural-chemical mechanisms in the hypothalamus sensitive to blood sugar utilization are important regulators of hunger and of eating. Thirst also involves hypothalamic regulation in signalling the need for water, and other mechanisms that control drinking behavior.

There are a number of automatic temperature controls to help maintain the body's temperature at a constant level. The learned activities of wearing clothes and using shelters are related to other motives as well as to temperature motivation.

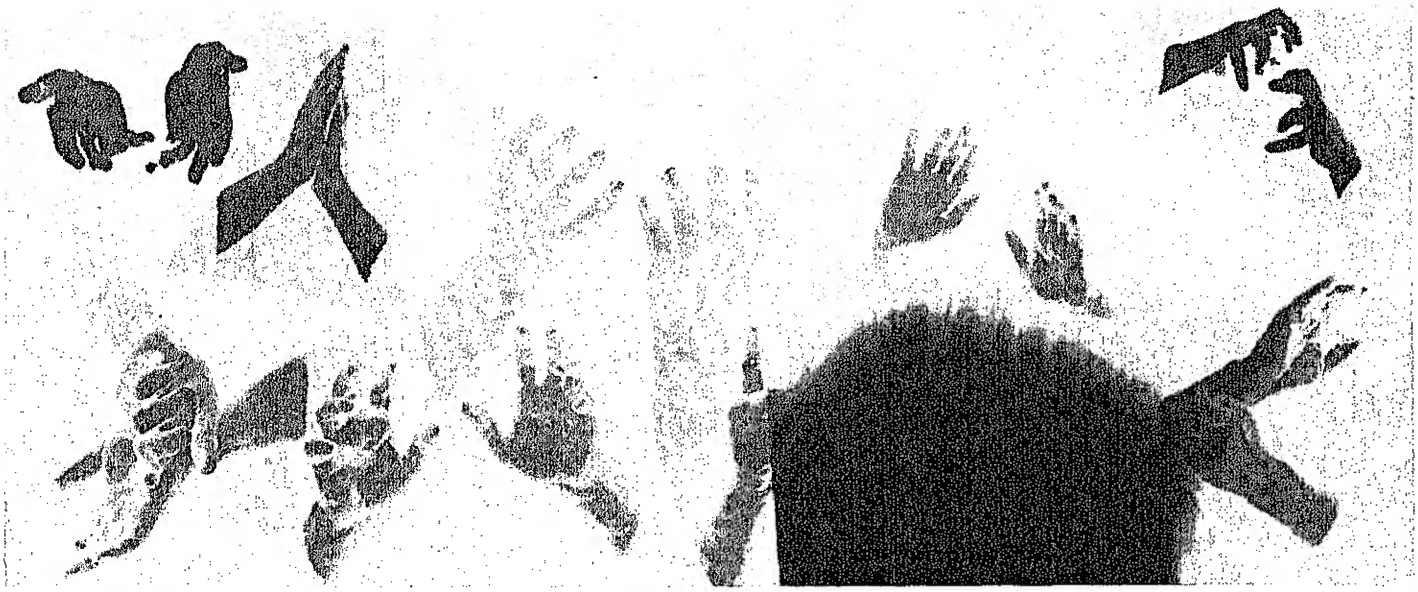
Sexual behavior is less dependent on hormonal controls in higher animals than in lower, and shows more learned variability. The human menstrual cycle does not usually produce changes in sexual behavior in the female, but is marked by general psychological variations. Maternal behavior is also related to hormonal balances.

Sleep patterns are partly learned habits which are regulated both by internal states and external environmental conditions. Dreaming and bodily activity during sleep are influenced by other motives.

General motives include emotional states, and activity and perceptual motives. Severe restriction of activity and perception leads to serious psychological disturbances. Learning and problem solving can be motivated by activity and perceptual rewards.

Drive conditions are unlearned physiological states related to the neurohumoral regulatory mechanisms. The hypothalamus is important in regulating both specific and general motives. However, almost all of man's motivated activity is learned, both in relation to primary goals and to learned secondary goals. Learned motives—especially social motives—often are maintained because of their emotional basis.

Economic motivation is based on several kinds of rewards: immediate job satisfactions, tangible rewards, and general values and ideals. Social interaction is an important factor in motivating the worker to maintain high production.



CHAPTER 7. EMOTION

Fifty years ago a young lady or young gentleman who wished to give dramatic readings in public could resort to books on "Elocution" to perfect his art. The books not only provided appropriate readings, but included photographs showing how to portray by the proper posturings and facial expressions all the interesting human emotions. "Are you in anguish?" Then wring the hands in such a manner, contort your features so. "Is it compassion, love, horror, you wish to portray?" Learn how to arrange your face, your hands, your body—and your audience will never be in doubt as to what strong feeling has you in its grasp. Or will they? The overt signs of emotion are but a small part of the total complex of emotional behavior.

There have been many attempts to classify separate emotions, but close scrutiny tells us that the classifications are not complete or meaningful. We know that some emotions are pleasant and some unpleasant, yet how often do we have an experience that is completely pleasant or completely unpleasant? We know that some emotions are stronger than others, that they vary in degree. Most of our daily living is colored by faint, almost imperceptible feelings of satisfaction, worry, annoyance. At other times strong emotion may dominate the life of an individual, transforming him into a dedicated fanatic, a raging, driving personality bent on revenge or retribution. But can we classify emotions on the basis of strength? Who can pinpoint the moment

when embarrassment becomes shame, when a startle becomes fear, when amusement becomes hilarity?

In order to understand something of the role played by emotion in human behavior, we must recognize that the various emotions are not separate and distinct, but rather aspects of a persisting emotional pattern. Emotion is not a simple response arising from a single cause. A pattern of emotional behavior may result from many causes—both direct and indirect, both internal and external—and may persist long after the triggering stimulus has ceased to exist. In this way emotion acts as a powerful motivating force driving the individual on and on in a sustained course of activity.

Stages of Emotional Behavior. There are three general stages of emotional behavior, as diagrammed in Figure 7.1. They are the activation pattern, or immediate emotional responses, emotional after-responses, and emotional habit patterns.

An emotional reaction is initiated by an emotion-producing stimulus situation. This stimulus may be a friend or loved one who is seen unexpectedly, or some terrifying occurrence, such as an explosion. There is first a startle reaction to the stimulus with heightened attention, and then a general reaction that typically involves a change in the level of activity. Along with this overt emotional response, a great number of internal muscular and glandular reactions occur, including variations in blood pressure, pulse, respiration, the amount of sugar in the blood, and the secretion of adrenalin. After a time this immediate reaction subsides and gives way to emotional after-effects. Some of the common immediate responses are given in the first column of Figure 7.1. Responses such as these can be classified as positive or negative. Posi-

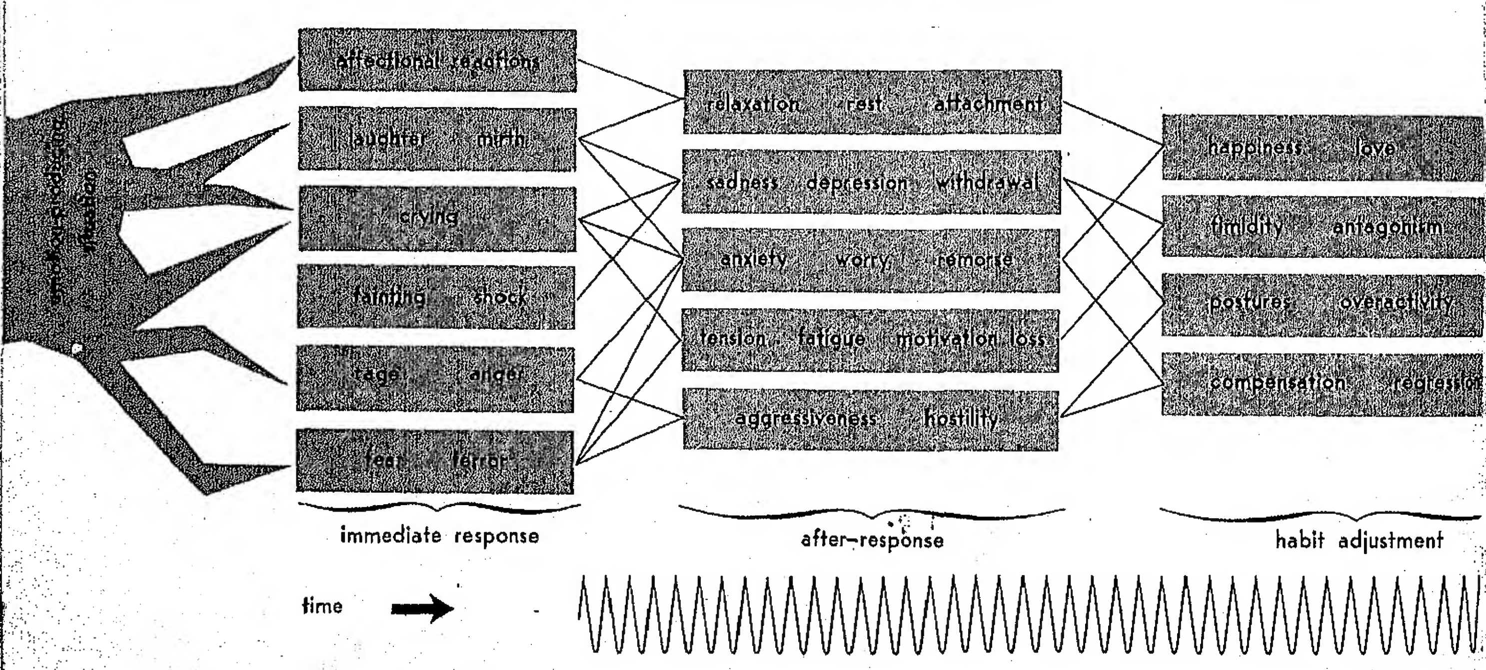


Figure 7.1. Stages of emotional behavior. Emotion is not a transitory response to a stimulus, but rather includes immediate reactions, emotional after-responses, and emotionally motivated patterns of adjustment. The immediate reactions are usually more intense, while the after-responses may be compensatory in nature. Many characteristic features of personality are defined by emotional habit patterns.

tive emotional reactions are those of approach, including response patterns of love, delight, and affection. Negative emotional behavior is characteristically of an avoidance or withdrawal nature, and includes also destructive or aggressive actions.

Emotional after-responses are sometimes of very long duration. The after-effects of extreme emotional shock, such as losing a loved one, may be more or less permanent. As shown in the second column of Figure 7.1, relaxation, rest, and attachment may follow affectional reactions. The after-effects of some of the stronger negative emotional reactions include anxiety, worry, and hostility. Most emotional upsets following fear and anger also involve fatigue and reduced motivation. The numerous interconnections shown between stages I and II indicate that a given emotional response is not followed invariably by the same after-effects. The effects differ in the same person at different times and differ remarkably from one person to another. For example, anger may be followed by anxiety or worry, or by aggressive reactions.

The after-responses of emotion are not just a continuation of the original emotional reaction, but represent in part preparatory reactions for subsequent adjustment. The hostility following anger is not a continuation of the overt action of the temper tantrum, but a general pattern of behavior that contains elements of the original anger as well as additional features of action. The relief that some people experience after indulging in a good cry or "blowing their top" illustrates that the after-effects of even negative emotional reactions possess elements of recovery or readjustment. It is interesting that a strong positive or pleasant emotional response is sometimes followed by such negative after-effects as sadness or withdrawal.

The third stage of emotional behavior shown in Figure 7.1 is that of long-lasting emotional habits, based not only upon the original emotional reaction but also upon the after-effects. Love is a term that is best applied to the complex of learned habits motivated by both the original affectional reactions and the relaxation and attachments that follow. Anxiety and worry, the common hangovers of negative emotional reactions, provide the motivation for many long-term habits, as we saw in Chapter 3. The process of habit formation based on anxiety is a matter of repeating those acts which remove or reduce the anxiety. Both positive and negative emotional reactions can contribute to one general set of habit patterns. Love and dependency are built in part on anxiety as well as upon affectional reactions and their after-effects.

The degenerative habit patterns associated with serious behavior disorders are based on the motivating effects of emotional disturbances. In problems of adjustment the typical pattern is one of emotional upset followed by the development of habitual behavior of such a nature that it can lead only to further emotional disturbance. Readjustment requires the breaking up of the vicious cycle of emotional disorganization. Still another manifestation of emotional disturbance is psychosomatic illness. Many serious physiological symptoms and organic disorders can be traced to the destructive effects of emotion. An all-too-common example is the high-pressured executive or airplane pilot with ulcers. Emotion is a complex pattern of internal and external behavior that affects both overt response and body physiology.

Because of the complexity of human

emotional behavior, the so-called emotions, or immediate emotional responses, cannot be enumerated with any degree of certainty. Emotional experiences shade and blend into each other so that even the well-recognized patterns are not always mutually exclusive. As emotionally motivated behavior proceeds through several stages, it changes character often in unpredictable ways. The interactions which occur between the responses at different stages and the flexibility of habit formation in relation to the various emotional reactions preclude any simple analysis of the role of emotion in general adjustment.

In this chapter we shall learn something about the various stages of emotional behavior, how they are initiated by both external and internal conditions, and how they are related to physiological processes and chemical interactions within the body. We shall see that the persisting nature of emotional reactions makes this aspect of behavior one of the strongest of motives.

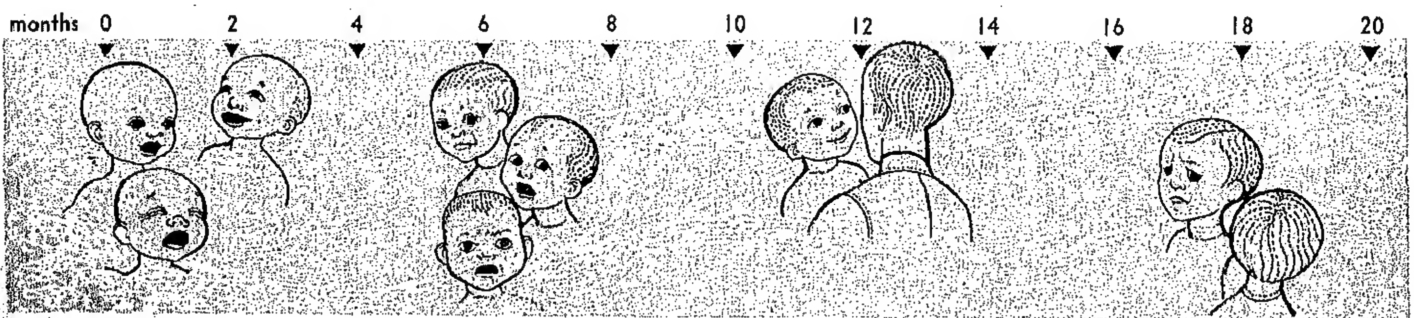
Figure 7.2. Differentiation of emotion in infants. At birth the infant displays only one emotion, a generalized state of excitement. In a month or two distress and delight can be distinguished; later fear, anger, disgust, affection, and jealousy. (Based on Bridges, K. M. B. Emotional development in early infancy. *Child Develpm.*, 1932, 3, 324–341.)

THE ACTIVATION PATTERN

There are several levels of description of emotional behavior. Traditionally, emotions have been identified by verbal or *introspective reports* of the individual's experience. On this basis, we distinguish among many varieties of feelings and emotions and give them names. We soon discover, however, that a personally experienced emotion is a difficult concept in scientific psychology. It will not be pinned down. It cannot be described objectively, and is apt to change character from one time to another. Furthermore, what we experience and like to describe as rage, or fear, or love, is apt to be a long-lasting experience—changing, developing, and growing. On another level we can describe the *overt bodily reactions* of emotion. Here we are concerned with how emotion is expressed by such reactions as movements of the face and hands, changes in the voice and in bodily posture, laughing, crying. Finally, a great deal is known of the *physiological changes* of emotion, including muscular, glandular, and other chemical or organic reactions of the body.

Although in our discussion of emotion we again and again must fall back on the everyday names for emotional experiences, we must remember that the correlations between emotions as we experience and label them and emotional patterns as they can be objectively described are far from perfect.

Differentiation of Emotional Behavior Patterns. Is it possible to distinguish certain basic emotions that are common to everyone? If so, these primary emotional patterns should be more easily identified in



infants and young children than in adults, whose emotional expressions have become modified through learning.

In one of the first general studies of emotional expression in infants, Watson concluded that there are three basic inborn emotions: fear, rage, and love.[1] He described the fear response as the catching of the breath, random movements of arms and hands, closing the eyes, and crying. Rage was described as a typical temper tantrum, stiffening of the body, striking, and flushing of the face. He described the infant's expression of love as smiling, cooing, gurgling, and cuddling.

Later studies of emotion in infants have not confirmed Watson's threefold classification. In order to give a name to an emotional pattern in an infant or young child, it is usually necessary to see the whole stimulating situation. That is, if we know what stimulus is affecting the child, we identify his emotional response as the one we think appropriate. If the stimulus is one which we think should provoke rage, then we say the infant's response is rage. However, if observers try to identify emotional responses in infants without knowing the nature of the stimulating conditions, they usually cannot agree on the nature of the emotion.

Bridges has concluded that in the first few weeks of life the infant responds to any highly stimulating condition with but one generalized emotion, excitement. Within a month or two, reactions of distress and delight can be distinguished, and these are followed by the gradual differentiation of a variety of emotional expressions. In the two-year-old child, affection, delight, elation, excitement, disgust, distress, jealousy, fear, and anger were identified. These stages are shown in Figure 7.2.

In young children emotional expression as a rule involves the whole body, as they let themselves go in a wholehearted portrayal of pleasant or unpleasant reactions. As children grow up, one of the things they learn is the desirability of masking the emotions to some extent. The overt patterns become minimized except in rare instances of extreme emotional arousal. There are still many observable indicators, however, in reactions of the face, hands, voice, and posture of the body. Facial expression is generally considered to be the best indicator of emotion. The drawings in Figure 7.3 represent the artist's conception of six distinct emotional expressions. Check your own judgment of each picture with the original interpretation as given in the caption.

The extent to which we can identify emotions in others depends on how accurately we can judge expressive movements of the face, hands, voice, and body. Many studies have shown that there is little consistency in our judgments of expressive movements unless they are judged in relation to the stimulating situation. For example, the expressive movements of a mother who has just seen her child run into the path of a car would be quite consistently interpreted as fear, although the expression out of context might be identified as any one of several unpleasant emotions.

Early in life, emotional behavior follows fairly universal patterns. Laughing, crying, tensing up in unpleasant situations, relaxing in pleasant ones—these and others appear to be unlearned reaction patterns. Through the years, individuals develop their own personal responses to emotion-arousing stimuli, and also adopt the stylized gestures, expressions, and inflections used

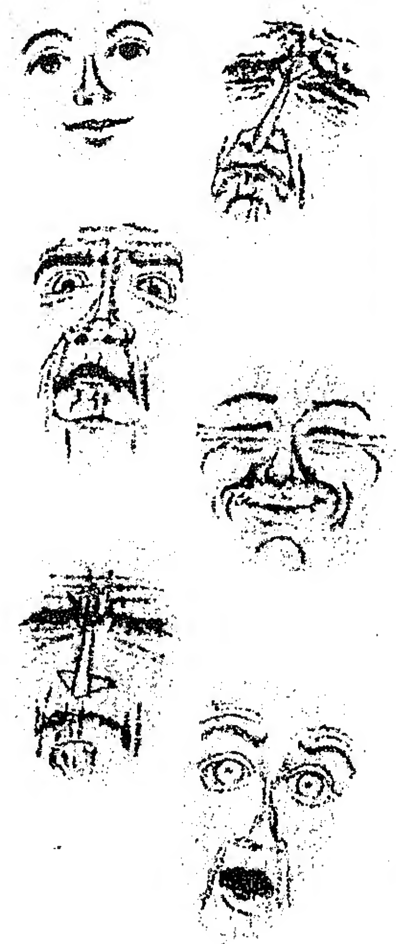


Figure 7.3. Facial expression of emotion. Check your judgment against the artist's labels of Affection, Pain, Terror, Amusement, Anger, and Surprise. Emotions can be judged better if the whole pattern of stimulus-aroused activity can be observed.

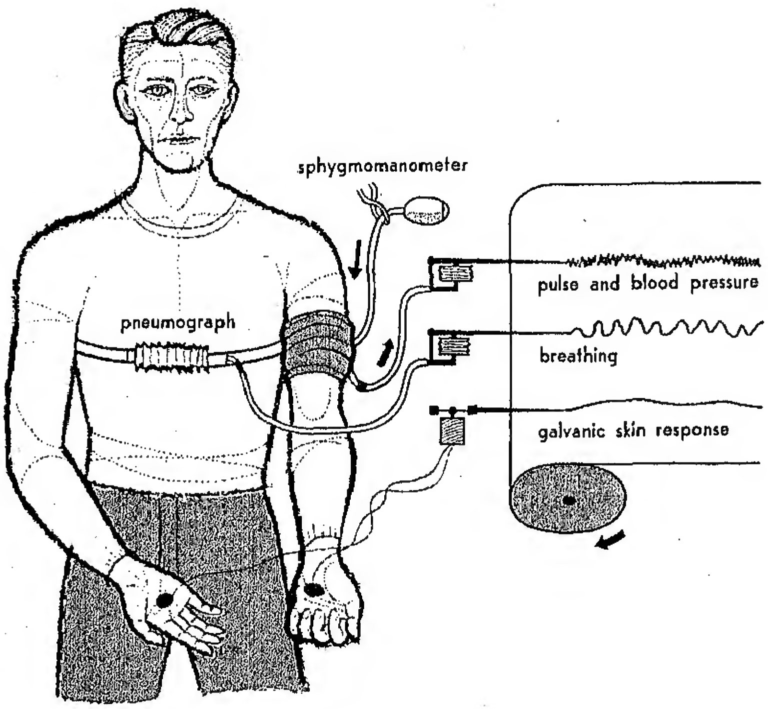


Figure 7.4. Measuring physiological changes in emotion. The "lie detector" measures changes in pulse and blood pressure, breathing, and electric resistance of the skin which occur as a part of emotional response to questioning. Lying is inferred from selective emotional response to different questions or words, but cannot be detected infallibly.

by members of their culture or social groups. An expression that means one thing to one group may mean something entirely different to another group or may have no meaning at all. In our culture the kiss is a common expression of affection. In other cultures it is not understood, and in still others it is considered so intimate as to be almost taboo.

Physiological Changes in Emotion. Along with the more easily observable behavior patterns, emotional responses involve a very complex series of internal bodily changes. Everyone knows some of the physiological phenomena of emotion — the flushed face or body, the catch of the breath, the fast heart beat, the sweat of fear, and the dry mouth of anxiety. These effects and correlated changes extend throughout all the major organs and glandular systems of the body.

One of the best examples of the practical measurement of the bodily changes in emotion is found in the use of the lie detector (Fig. 7.4). This apparatus records four types of physiological emotional response during questioning: variations in pulse rate, blood pressure, breathing rate, and the galvanic skin response. Pulse and blood pressure are recorded by a system similar to that used by a doctor when he measures blood pressure. A rubber sleeve wrapped around the upper arm is connected to a rubber bulb and an air-pressure recording system. When the air pressure in the sleeve is pumped up to equal the blood pressure level of the subject, the recording arm shows the periodic pulse changes and the slower variations in blood pressure. Respiration is recorded by another air-pressure device strapped to the chest. The fourth response recorded, the galvanic skin response (GSR), is a change in the electrical resistance of the skin correlated with increased perspiration during an emotional state. The skin resistance decreases as perspiration increases. This response is recorded by electrodes attached to the palm of the hand.

The use of the lie detector is based on the fact that any emotional responses of the person submitting to the test are clearly observable on the permanent record. A subject responds emotionally when he is given a question or word relating to an event that he is attempting to hide. The decreased skin resistance, the catch of the breath, and the increased pulse and blood pressure are recorded as shown in Figure 7.4. It is significant that these changes occur even in artificial situations, such as the detection in a classroom of a "play"

crime committed by a student. The emotional system is a highly sensitive mechanism that responds to very minor changes in the environment.

Because of the widespread use of lie detectors, it is very important to know how accurate they are in identifying deliberate falsehoods. Recent experimental studies show clearly that the accuracy of emotional indicators in spotting deception is limited.[2] When various measures of circulation, of the GSR, and of breathing were used in an experimental situation, only about 75 percent of deliberate liars could be correctly identified, although the accuracy of identification was raised to 80-90 percent by combining the results of several indicators statistically. In a real-life situation where the possibility exists of there being no liars among suspects of a crime, the reliability of the lie detector is questionable. This device should be used therefore with the greatest caution and under the guidance of professionally trained people.

Aside from practical considerations, the measurement of the physiological variations in emotion is basic to an understanding of the neural and hormonal regulation of emotional behavior. Of great significance in this respect is the study of variations in brain waves brought about by emotional situations. In Chapter 4 we spoke of recording these electric changes of the brain in relation to different levels of activity. Figure 7.5 shows how electrodes are placed on the head to record brain waves on the *electroencephalograph*. (For a photograph of this recording situation, see Fig. 1.1*d* in Chapter 1.) Two separate recordings are shown in the figure —one from the frontal part of the head, and one from the posterior or back part. The large rhythmic waves shown in the record from the posterior region in Figure 7.5*a* are called *alpha waves*, or the "Berger rhythm," named after the Viennese psychiatrist who invented the electroencephalograph and first described brain waves.[3] They are characteristic of brain activity during relaxation or sleep, and are maintained without specific external stimulation. When the subject is stimulated suddenly by a light or sound, as indicated in Figure 7.5*b*, the alpha rhythm is blocked for a short time and then returns. During a state of apprehension or anxiety, the alpha rhythm is absent for long periods (Fig. 7.5*c*).

What do these changes mean in terms of neurohumoral regulatory mechanisms? When specific stimulation inhibits the alpha rhythm, the resulting brain activity is what we have called the activation pattern of the brain. During an emotional state, recorded brain waves show a continuous activation pattern, even though there are no specific external stimuli acting on the individual. This condition is reflected in the heightened activity of the individual in bodily tension and physiological responses. The emotional activation pattern is related to neural discharges from the hypothalamus to the higher centers of the brain. We shall come back to this problem later in the chapter.

Emotion as a Total Response. Emotional behavior is typically a pattern of total response, involving the whole organism. The unpleasant emotions can be thought of as emergency reactions, which mobilize the resources of the entire body to deal with a threatening situation.

The startle pattern. The startle reaction is a striking pattern of emotional reaction fairly consistent from one person to an-

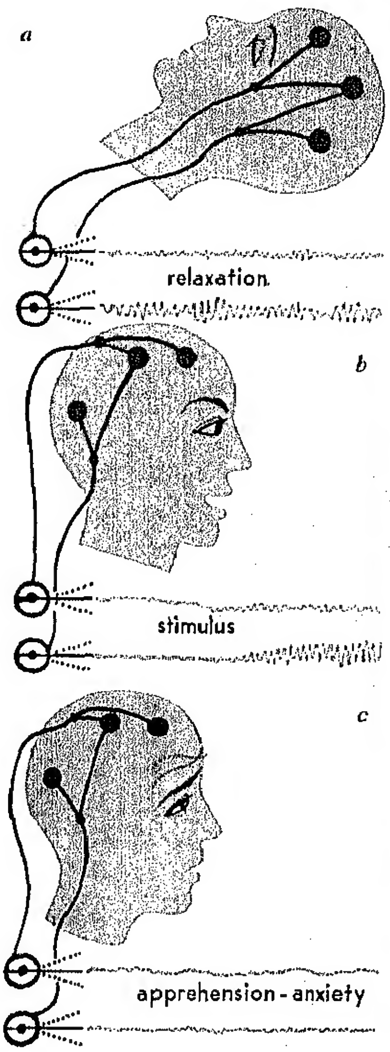


Figure 7.5. The activation pattern of the cortex during emotion. Brain waves typical of a state of relaxation, a, *are inhibited by external stimulation,* b. *The same activation pattern is observed during apprehension or anxiety,* c, *brought about by impulses from the hypothalamus.* [Based on Lindsley, D. B. Emotion. In Stevens, S. S. (Ed.) *Handbook of experimental psychology.* New York: Wiley, 1951. Pp. 473–516.]

Figure 7.6. *The startle pattern. A sudden, startling stimulus, such as a pistol shot, produces a transient startle reaction involving the whole body.* (Adapted from Landis, C., and Hunt, W. A. *The startle pattern.* New York: Farrar and Rinehart, 1939.)

other (Fig. 7.6). This entire response takes place so quickly that it is not often seen with unaided vision. Experimental observations of startle have been made by means of high-speed motion pictures. The pattern consists of a rapid postural change characterized by straining the neck muscles, lifting the shoulders, drawing the arms forward, and crouching slightly. At the same time, the eyes blink and the mouth is drawn into a "grin." The reaction time for the contraction of the muscles of the neck is approximately .025 to .05 seconds.[4]

The startle pattern may be regarded as a preparatory posture which occurs in response to sudden stimuli that may arouse fear or rage. The reaction appears consistently in almost everyone except epileptics, and is not altered by adaptation or learning. Its existence is evidence for the primitive nature of certain phases of emotion.

The fear-rage pattern. In a threatening situation, the startle pattern may be followed by reactions of fear or rage. One type of rage response is the fighting activity of overt aggression (Fig. 7.7). In a typical fear response, the individual attempts to run away. Or he may be immobilized and then display rage reactions directed toward himself. The latter reaction, if it occurs, usually is followed by depression.

The fear-rage response marshals the internal resources of the body in preparation for violent sustained action.[5] Fear and rage are emergency actions in which the heart speeds up, blood is diverted from the internal organs to the skeletal muscles, and more body sugar is released into the blood. The breathing rate is interrupted and the pupils of the eyes get larger and admit more light. All of these changes are influenced by the release of adrenalin from the adrenal gland during the emotional reaction.

The faint. Extreme shock or fear in a threatening situation may lead to the emotional faint. The typical pattern of behavior leading up to fainting is shown in Figure 7.8. Preliminary stages include feelings of muscular weakness, sweating, feelings of nausea, sighing and yawning, light-headedness, and blurred vision. In the faint itself,

Figure 7.7. *The rage reaction. In an emergency or threatening situation, the internal resources of the entire body are mobilized in reactions of fear or rage.* (Courtesy Student Photo Service, Princeton Univ.)

the individual turns pale, falls down in a coma, and may lose control of bodily functions. Fainting is primarily a result of the pooling of blood in the lower regions of the body due to reduced pressure in the veins. Any condition that causes this reduced pressure may lead to fainting. When the person falls in a prone position, the blood is redistributed to the upper regions of the body, including the brain, and recovery usually occurs quickly.

Some of the specific stimulating conditions that lead to fainting are shown in Figure 7.8. The fainting of soldiers who have had to maintain an upright posture on the parade ground, or of patients anticipating a hypodermic shot is well known. It is popularly believed that women are more prone to fainting than are men, but the reverse is probably true.

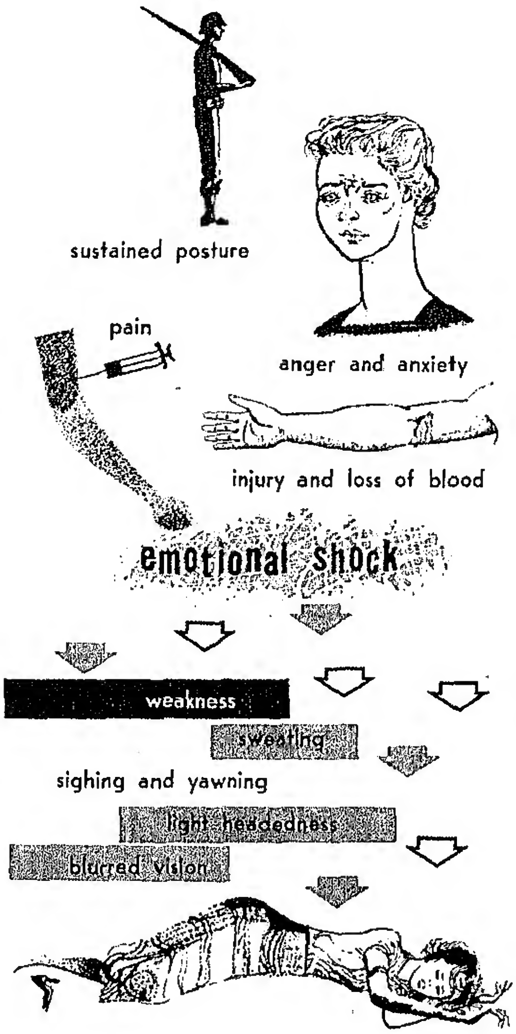


Figure 7.8. Causes and stages of the faint. Fainting is a total response which may be induced by many physiological or emotional reactions which cause reduced pressure in the blood vessels and consequent pooling of the blood in lower parts of the body.

EMOTIONAL AFTER-EFFECTS

Almost everyone knows something of the striking after-effects of strong emotion, either pleasant or unpleasant. After the initial emotional reaction has passed, the "emotional hangover" sets in. We have already identified some of these effects in Figure 7.1—relaxation, depression, withdrawal, anxiety, tension, fatigue, and hostility. All of them are important in contributing to the general organization of behavior. As we saw in Chapter 3, the anxiety of frustration is a persisting state which leads to the formation of new patterns of response.

Affectional After-responses. The after-effects of the affectional reactions and sexual activity—that is, sleep, relaxation, and attachment—are emotional by-products of importance in general adjustment. These states are similar to the feelings of well-being that follow bodily exercise or eating.

The positive emotional after-effects motivate the individual as much as do negative effects such as anxiety. Many recreational activities and social attachments are based on affectional states. The supper club, the beer-drinking club, and the dance group

a

b

Figure 7.9. The disaster syndrome. In a disaster, some people recover quickly from the initial emotional shock and go to the aid of others, a. *Others show prolonged emotional after-effects, including disorganized activity and apathy,* b. *Confusion, bewilderment, listlessness, and fatigue may persist for weeks.* (Courtesy *Worcester Telegram and Gazette.*)

are formed not on a transient emotional experience, but on the broader foundation of persisting states of satisfaction and well-being. As noted above, such persisting effects are also the basis of the complex learned activities related to love and romantic attachments.

After-effects of Fear and Rage. The after-effects of fear and rage are very complex and subject to wide variation. These persisting states of emotional origin are the basis of what has been described as the "disaster syndrome," or the pattern of behavior sometimes seen in people who have suffered a disaster.[6]

After a terrifying accident or disaster such as a fire or tornado, some people pick themselves up, show only mild effects, and rush to the help of others (Fig. 7.9*a*). Others show marked rage or hysterical behavior and then may recover quickly without showing long-lasting shock effects. A third group, however, including some who are injured and others who are not, show the disorganized behavior of the disaster syndrome. Some run about randomly, doing foolish and ineffectual things. A typical example is the man in the Worcester tornado who tried to sweep up tons of debris with a broom. Some show fixated behavior, in carrying worthless things about, talking and humming in a stereotyped fashion even while loved ones are lying dead or injured nearby. They cannot pay attention to others, or remember what happens or what they are told. They cannot evaluate the devastating event that has occurred. They show an emotional flatness, an insensitivity, similar to the behavior shown in one type of serious behavior disorder.

The initial shock reactions may be followed by a staring, dazed apathy (Fig. 7.9*b*).

The people affected by this reaction stare into empty space, confused and bewildered by the destruction of their personal world. Some think that the universe has come to an end. When help comes, these people may come out of their apathy and become overly affectionate to those who have come to help them. They give themselves over to the care of others, becoming obedient and suggestible.

Although most people affected by a disaster recover and show a resurgence of community spirit and cooperative enterprise, some never quite get over the shock or rise out of the apathy. They remain listless and fatigued, and can neither work by day or sleep at night.

These disaster reactions are exaggerated forms of the typical after-effects of strong negative emotion. The emergency activation pattern of fear and rage cannot be tolerated for long by the organism. The body shows an emotional recovery period characterized by fatigue, apathy, and depression. After strong fears or angers recede, the states of anxiety and depression may occur in cycles.

These negative emotional after-effects have motivating value because the organism strives to remove them. Responses which reduce tension and anxiety or eliminate fatigue and depression are repeated and learned. Such emotional habit patterns as alcoholism, drug addiction, and delinquency are evolved in this way.

Psychosomatic Reactions. During emotion, strange things happen to the human organism. The after-effects of strong emotion can interfere with normal psychological processes, including motor performance, learning, and memory, and can also exert a powerful influence on what are usually considered the physiological functions of the body.

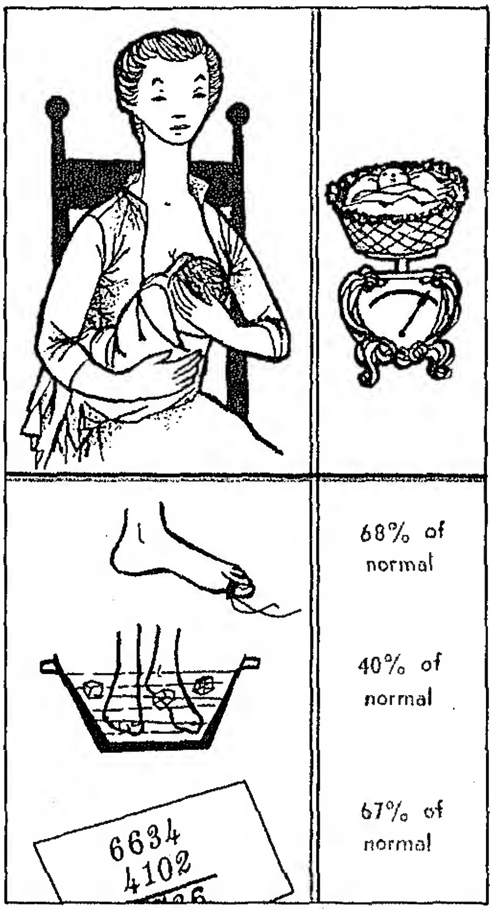


Figure 7.10. Effects of emotional stimuli on the milk-giving reflex. Emotional stimulation reduced the amount of milk given by a breast-feeding mother. The stimuli used were pulling the big toe, immersing the feet in ice water, and solving problems under threat of mild punishment. (Based on Newton, M., and Newton, N. R. The let-down reflex in human lactation. *J. Pediat.*, 1948, 33, 698–704.)

The experimental results summarized in Figure 7.10 show how even mildly upsetting conditions can seriously affect a normal physiological function—in this case, the milk-giving reflex of a nursing mother. The plan of the experiment was to present various disturbing stimuli directly before the time of nursing. The seven-month-old baby was weighed before and after nursing to determine the amount of milk taken, which was then compared with the normal

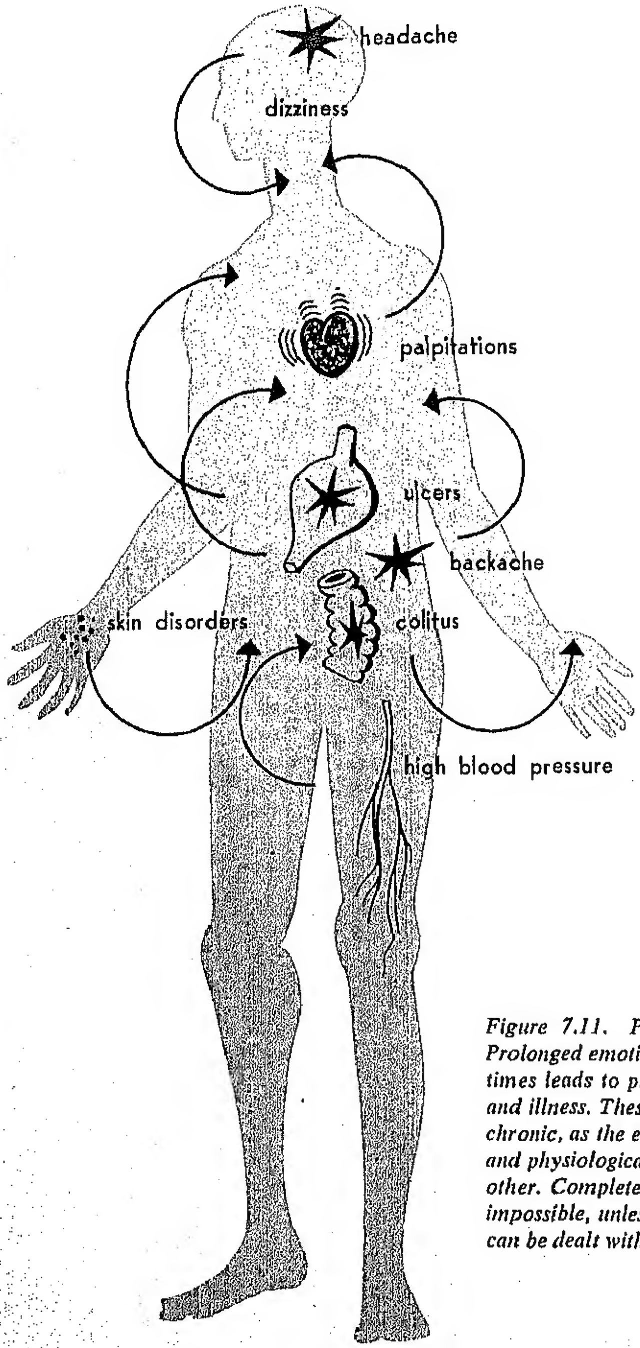


Figure 7.11. Psychosomatic illness. Prolonged emotional disturbance sometimes leads to physiological dysfunction and illness. These effects often become chronic, as the emotional disturbance and physiological disorder intensify each other. Complete "cures" are usually impossible, unless the emotional aspects can be dealt with effectively.

amount taken at a feeding. The three stimulus conditions used were pulling the big toe of the mother, immersing her feet in ice water, and requiring her to solve mathematical problems correctly in ten seconds or be punished by a mild electric shock. As shown in the figure, about two-thirds the normal amount of milk was given following the toe pulling and problem solving, while only 40 percent of normal was given after the shock of immersing the feet in ice water.

Once again we see that physiological adjustments as well as overt behavior are highly responsive to changes in the environment. One can readily imagine the effects of sustained emotional disturbance on the milk production of a nursing mother. Let us suppose that after the young mother's return from the hospital marked tension has arisen between her and her husband. The emotional situation affects her ability to nurse the new child, the child's feeding is in turn disturbed, and the mother is affected further by her own insufficiency in maternal care. The after-effects of emotion can act destructively on a normal physiological function and persist on a long-term basis.

Emotion sometimes affects or interferes with physiological functions so seriously that the individual becomes ill. We call the emotionally induced illnesses *psychosomatic* diseases, a term which arose from the popularly held notion of emotion as a mental state acting on the body. The word is ill-chosen. Some disorders of body function are produced by foreign organisms, some by structural breakdowns, and others by emotional habit patterns. The latter are psychosomatic. Fifty percent *or more* of all illnesses are thought to be of emotional origin.

Psychosomatic disorders range from such common symptoms as headaches, constipation, and a lump in the throat to very serious or unusual disorders. Some forms of emotionally induced disorder are indicated in Figure 7.11. The emotional disturbance and the resulting disorder contribute to the vicious cycle of psychosomatic disease, with each aspect influencing and intensifying the other. Some of these disorders are widely recognized as primarily emotional in origin—high blood pressure and ulcers, for example. Ulcers are familiar events in the lives of executives and workers subject to continual tension or stress. The field of television is sometimes given the name "ulcer alley." Less widely recognized are the emotional aspects of certain other disorders—colitis, some sexual disorders, backache, asthma, and skin disorders.

The knowledge and recognition of emotionally induced disorders should lead to increasing caution in medical diagnosis and to improvement of the psychological relations between doctor and patient. However, the overemphasis on emotion as a contributing condition to disease is as dangerous as its underemphasis, if it blinds either the doctor or the patient to conditions of an infectious or structural nature. Wider understanding of the phenomena of emotion should lead, in time, to improved methods of both diagnosis and treatment in medicine.

Emotion as a Social Phenomenon. Emotion is both an individual characteristic and a social phenomenon. It is an infectious sort of thing which on occasion can spread through a community like the plague. Starting from a single stimulating source, an emotional epidemic of fear or hate spreads by word of mouth and by overt example of individual emotional response until it can sweep an entire nation. Eventually the panic subsides and then dissipates.

Such an epidemic would never occur if emotions were only transient reactions in each individual. It is the persisting after-effects of emotion, building up over a period of time and gaining strength by the interplay among individuals, that lead to the social panic. Both rumor and direct action serve as the media of communication for social hysteria. The epidemic manias of the middle ages, the hypnotic power of a Hitler rally, and the unfounded panics which sometimes rock our own communities are the socially magnified common excitements and fears of ordinary individuals.

The sustained anxiety, depression, and hostility following in the wake of overt fear and rage reactions may structure the human relations of a whole group, a community, or a nation. Thus, in a community divided by industrial warfare, in which union workers, scab workers, and industrial management are in conflict, a pervading emotional atmosphere colors all activities of the town. The original overt emotional reactions pass, but the hostility, aggression, anxiety, and depression linger on.

One of the challenges of modern science and society is to learn how to deal with the persisting effects of emotional excitement, fear, and hate. Understanding these sustained effects may give us some real insight into the social fads and upheavals occurring periodically in our communities. For example, college riots are rarely the product of criminal thinking, but are usually the expression of emotional disturbance and frustration common to large groups of stu-

dents. We can deal more effectively with these problems, as well as more serious social hates and angers, the better we understand the timing and social communication of emotional expression.

EMOTIONAL HABIT PATTERNS

Much of the color and energy of human life is centered about emotionally based habits. There was a time when psychologists and others looked upon habit as almost entirely a product of mechanical practice, of repeating the proper reactions to achieve a goal or reward. We have only gradually come to realize the importance of emotion as a motivating force in habit formation. The learned patterns of conduct which structure our lives develop largely in response to emotional demands.

Emotional habits, representing the third stage of emotional behavior, are built upon both the activation pattern and the persisting after-effects of emotion. The individual is strongly motivated to prolong or seek those events that give him emotional satisfaction, and to avoid those that induce negative emotional effects. Some of the positive habit phenomena of emotion are the behavior patterns of love, happiness, loyalty, and enthusiasm. Negative habits, which evolve out of anxiety, worry, and fatigue, include timidity, negativism, fantasy habits, use of drugs and alcohol, peculiar postures and mannerisms, overactivity, antisocial patterns of behavior, and forms of delinquency. In Chapter 3 we discussed some of these negative habits, along with the substitute responses of compensation, sublimation, identification, regression, and others. All of these modes of behavior involve substituting some indirect activity for direct solution of a problem. They serve to reduce in part the negative emotional after-effects which motivated their learning.

Emotional habits represent the persisting core of motivated behavior in the individual. Any effort to make or break habits must deal first of all with the emotional component. Unless we have the knowledge or skill to exercise some control over emotional response, we can effect very little change in related habit patterns.

Learning during Stress and Anxiety. Conditions of stress and anxiety not only motivate the individual to learn habits which will alleviate the anxiety, but also affect unrelated behavior occurring at the same time. In particular we are interested in the effects of stress on the learning of new forms of response. Figure 7.12 describes an experiment investigating the effects of persisting emotion on conditioned-response learning and verbal learning. College students and teachers were studied during three conditions of real-life stress: the periods just preceding doctoral examinations, important oral reports before a class, and first-night appearances in dramatic productions. Almost anyone who has gone through one or another of these activities would agree that they are stressful, but just to make sure that the subjects were indeed emotional, the experimenter measured their GSR under normal and stressful conditions. Comparison of the two measures showed that the subjects were responding emotionally to all of the conditions of stress.

The fifty-four subjects were given learning tests under two conditions—normal and stressful. Observations for the stress conditions were made on the same day that the individual was to take the examination,

give the report, or appear on opening night. Observations for normal conditions were carried out ten days in advance of "stress day" for half the subjects and ten days afterward for the other half. This reversal of testing procedure was to insure that the order of testing would not influence the results. The two kinds of tests used were the learning of lists of nonsense syllables, and conditioning of the GSR to a light. The conditioned-response procedure was as we described it on page 135. First the conditioned stimulus, a light, was presented, and then the unconditioned stimulus, a light electric shock to the hand. After a number of conditioning trials, the resulting change in electrical skin resistance, the GSR, could be elicited by the light alone. Half of the subjects were conditioned under the stress conditions, and the other half under normal conditions. For the serial learning, two lists of nonsense syllables of equal difficulty were used. One list was learned under the stress condition and the other under the normal condition.

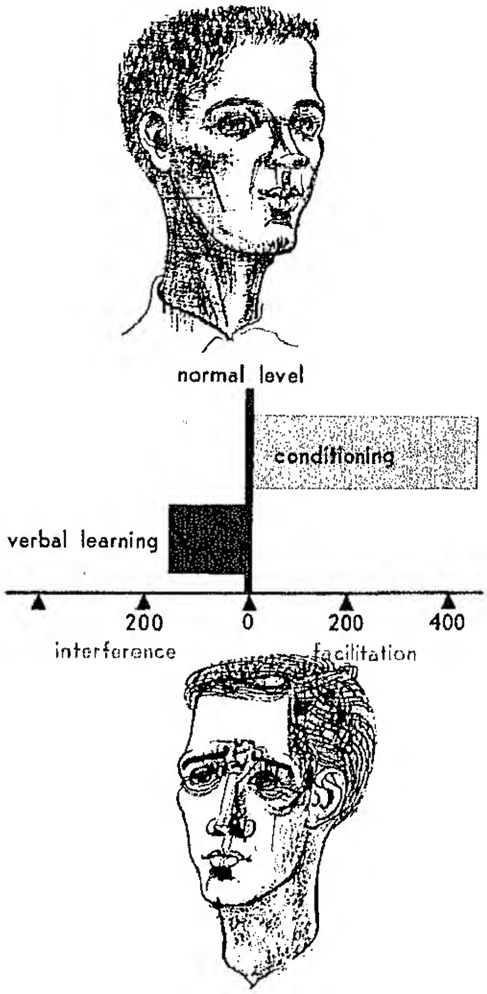


Figure 7.12. Learning during stress and anxiety. Students under real-life stress showed 1½ times poorer scores in verbal learning than normal, but conditioning of their GSR, a reflex tied in with primitive emotional responses, was greatly facilitated. (Adapted from Beam, J. C. Serial learning and conditioning under real-life stress. *J. abnorm. soc. Psychol.*, 1955, **51**, 543–551.)

As shown in Figure 7.12, conditioning scores for the stress conditions were more than four times larger than those for the normal conditions. In other words, the emotional disturbance facilitated the conditioning of the GSR very greatly. However, the rate and precision of verbal learning under stress were about one-and-one-half times poorer than under normal conditions. Other studies of the effects of anxiety on learning show that, in general, people with high scores for anxiety are conditioned more readily but learn verbal and skilled tasks less easily than individuals showing low levels of anxiety.

How can we account for these opposite effects? One explanation is that the responses used for conditioning tests, such as eyelid blinking or GSR, are directly related to primitive emotional reaction systems. Hence they are conditioned more rapidly under stress and anxiety than normally. We see this effect in the emotionally disturbed individual who is so "jumpy" and "high-strung" that he reacts emotionally to all sorts of incidental stimuli. However, the same emotional tensions have the opposite effect on the learning of higher-level skills. The tensions of emotional disturbance interfere with the

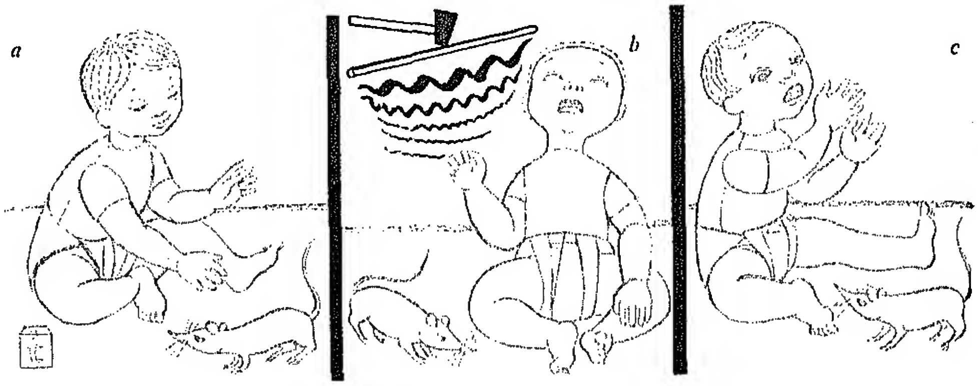


Figure 7.13. Conditioned emotional response. A child who played happily with a white rat, a, *learned to fear the rat,* c, *after it had been presented several times with a fear-provoking loud sound,* b. *Incidental conditioning is the source of many irrational fears, which are very persistent.* (Based on Watson, J. B., and Rayner, R. Conditioned emotional reactions. *J. exp. Psychol.*, 1920, 3, 1–14.)

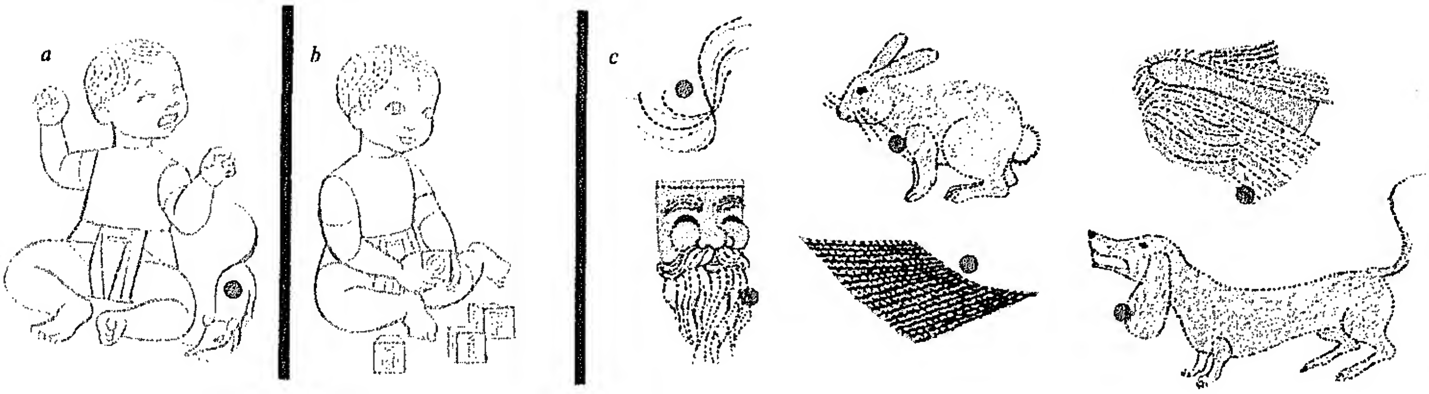
high degree of perceptual-motor coordination required to learn verbal habits and other skilled activities.

DETERMINANTS OF EMOTIONAL RESPONSE

Thus far in our discussion of emotion we have been concerned mainly with the nature of emotional behavior. We have considered the variations in overt behavior and physiological changes which constitute the activation pattern of emotion. We have gone on to show how the emotional after-effects act as powerful motivating conditions to influence the development of habits and general patterns of adjustment. Now we are going back to see if we can learn something about the stimuli that elicit an emotional response. We know that every individual reacts emotionally to a wide variety of stimuli. We also know that a stimulus which may arouse a person at one time may in another situation "leave him cold." What are the determining factors in emotional response?

The Nature of Emotional Stimuli. It often has been thought that many emotional responses are universal and therefore inborn—fear, for example. It might appear that almost everyone is afraid of large animals, fire, snakes, or falling. Yet psychologists who have studied emotions in infants have found that there are very few stimuli which invariably elicit emotional response. Watson tried to arouse emotional behavior in infants with a wide variety of external stimuli, but for the most part his attempts were unsuccessful.[1] He observed that infants gave responses resembling fear to loud sounds and loss of bodily support, and that restriction of bodily movement produced a rage response. Positive emotional responses, which he called love, were elicited by stroking or fondling. His general conclusion was that there are very few *unlearned* emotional stimuli.

A further study demonstrated how emotional reactions can be conditioned to new stimuli. Figure 7.13 shows the steps followed in teaching a cheerful eleven-month-old boy, Albert, to fear a white rat. At first, Albert showed no fear of the rat and tried to play with it (*a*). In the conditioning stage, the rat was given to the child shortly before a loud sound was produced by striking a metal bar (*b*). The sound elicited a startle reaction followed by crying, a typical fear response. In subsequent trials



these paired stimuli, first the rat and then the sound, were repeated, until Albert developed a full-fledged fear reaction to the rat (*c*), in striking contrast to his original play behavior. From this study and others we conclude that negative emotions are very quickly conditioned and that the learned emotional reaction persists for some time even in the absence of the unconditioned stimulus.

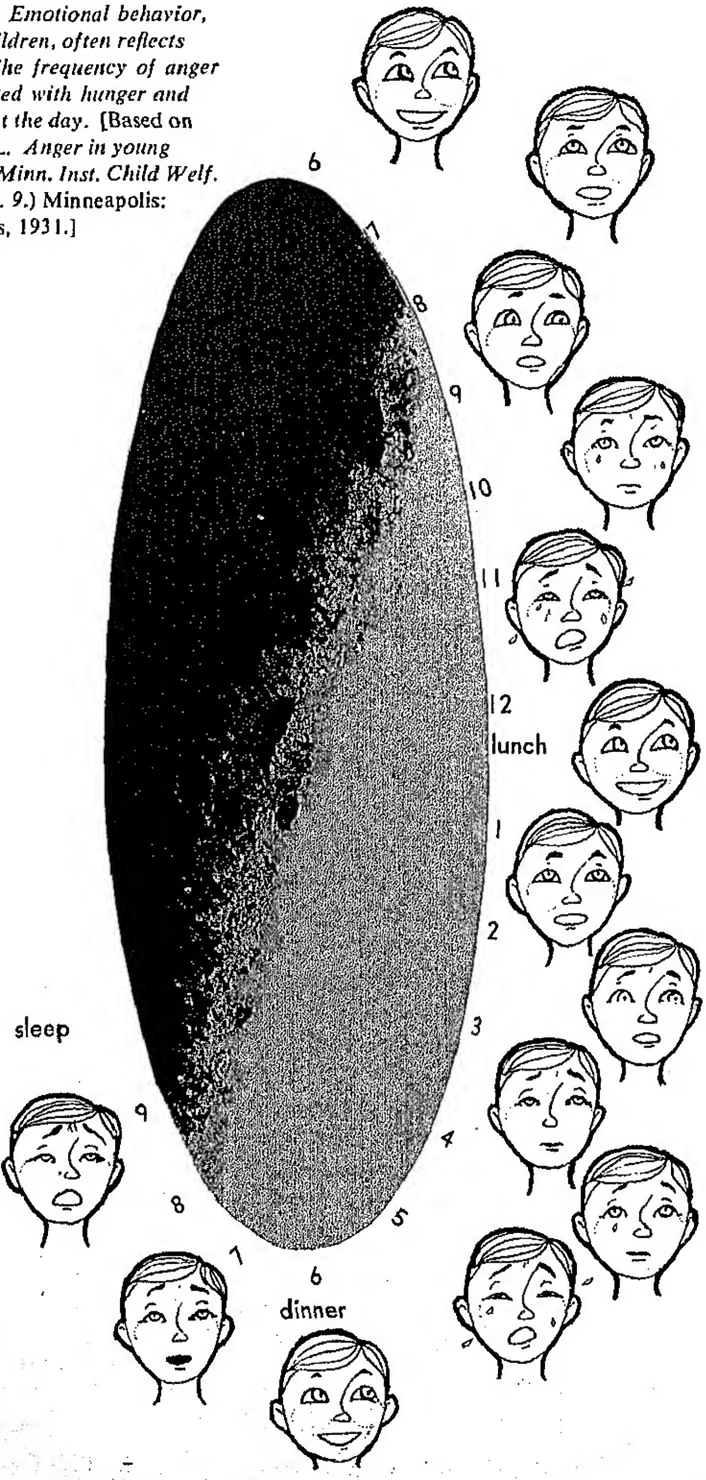
The second phase of this study dealt with the question of whether the conditioned emotional reaction to the white rat could be transferred to other objects (Fig. 7.14). Several days after the conditioned response to the rat had been established, Albert was given blocks which he had played with between trials in the conditioning situation. He displayed no fear of the blocks. Then a number of "furry" objects were presented to him, a rabbit, a dog, a fur coat, wool, human hair, and a Santa Claus mask with a beard. Albert had played with all of these objects before conditioning to the rat, but now in the post-conditioning tests the learned fear response was transferred or *generalized* to the furry objects. The strongest reactions occurred with the animals and the fur coat. Thus the original emotional learning resulted in negative emotional responses to a large number of stimuli. Further experimentation with Albert proved conclusively that fear of the rat was learned much more readily than it was unlearned.

These experiments describe the procedure by means of which emotional responses, originally given to very few external stimuli, become attached to a wide variety of objects and situations. The same sort of emotional learning can be demonstrated in animals. We have already described in Chapter 3 how fear induced in rats by a shock was transferred to the situation in which the shock occurred. The apparent ease with which a fear response can be transferred to an irrelevant stimulus helps to explain the irrational fears which most of us develop at one time or another. The same mechanism of emotional learning also accounts for the seriously disturbing fears and phobias seen in some forms of behavior disorder. It is but a poorly defined step from "normal" emotional response to the emotionally based disturbances of mental illness.

Emotion and Internal States. The arousal of emotion depends upon more than a specific external stimulus. We all have experi-

Figure 7.14. After the child in Figure 7.13 had learned to fear a rat, a, *he still played happily with the blocks which had been present in the experimental room,* b, *but generalized his fear reactions to many other furry objects, such as those pictured,* c. (Based on Watson, J. B., and Rayner, R. *Op. cit.*)

Figure 7.15. The emotional clock of the healthy child. Emotional behavior, particularly in children, often reflects internal drives. The frequency of anger outbursts correlated with hunger and fatigue throughout the day. [Based on Goodenough, F. L. *Anger in young children.* (*Univ. Minn. Inst. Child Welf. Monogr. Ser., No. 9.*) Minneapolis: Univ. Minn. Press, 1931.]



enced times when we are "walking on air," are "on top of the world," when life is good and petty annoyances are just that—trivialities that can be ignored. Then there are the bad times, when we "get up on the wrong side of the bed," or "have a grouch on." In times like these nothing seems good, and we take pleasure only in the violence of our displeasure. These shifts in mood or feeling from hour to hour or day to day arise from events inside the body, and not specifically from the world outside. Many fluctuations in emotion are related to internal drive states and the satisfaction of these drives. Thus the effects of external stimuli depend on the present condition of the organism and its neurochemical regulators.

There are many bodily mechanisms which influence emotion, directly and indirectly. As we learned in the chapter on motivation, emotion is integrated internally with the mechanisms of physiological drives. Changes in the specific drive states of hunger, thirst, sex, temperature control, and others on occasion can induce emotional reactions and also can help determine the nature of the individual's emotional response to external stimuli. The conflict of motives within the individual also induces emotional behavior.

The relation of emotional behavior to hunger cycles is particularly obvious in children, and has been substantiated by observations of the frequency of anger outbursts in young children throughout the day. The results of this study are summarized diagrammatically in Figure 7.15, as the emotional clock of the healthy child. Early in the morning the youngsters in this study, like most young children, were on their good behavior. By about 10:30 A.M., however, outbursts of anger became fre-

quent and remained so for the rest of the morning. Lunch had a soothing effect, and the clock moved on serenely. By 4:30, tempers were wearing thin, and 5:30 saw as many tantrums as did the morning peak. Dinner pacified the children for an hour or so, but by bedtime angry behavior was again on the increase. In these peaks of anger around 11:30, 5:30, and 8:30, the frequency of outbursts was almost double that of the low points.

These results point up the fact that the emotions of children are cyclic due to the variations in specific drive states. However, emotional behavior induced by internal stress is directed toward objects and people in the environment, and the resulting social interaction can amplify emotional response. For example, two hungry children together can get much more emotional than one alone. A child—or an older person—may develop a pattern of intense emotion that to the superficial eye has no rational foundation.

Physiological states other than hunger can be shown to produce or affect emotional behavior. In our discussion of the female sex cycle in the last chapter, we saw how varying moods are related to different phases of the cycle. Any strong drive state has emotional overtones, and the interrelationships between emotion and other motives are so complex as not to be easily understood. The personal character of emotion—that is, the unique organization of emotional and motivational behavior within the individual—lends dynamic force to personality.

EMOTION REGULATORS

The behavioral phenomena of emotion have well-defined foundations in the neural and glandular systems of the body. We have said that emotion is a total integrated response involving the body as a whole. Thus we see that the activation pattern includes overt reactions of the skeletal muscles as well as reactions of the glands and of the smooth muscles of the viscera. This means that all parts of the nervous system have a role in emotional behavior. However, the division of the nervous system which supplies the glands and internal organs, known as the *autonomic nervous system,* is more intimately involved in emotion than the system supplying the skeletal muscles. Emotional reactions can occur without precise correlated effects in skeletal muscles and their neural regulators, but emotional reactions always involve the autonomic nervous system.

The Autonomic Control of Emotion. Two antagonistic neural systems regulate emotional response. One of these systems is dominant when the individual is relaxed and when his emotional mood is quiet and pleasant. In periods of marked activity or stress, as in fear or anger, the second system of control is dominant. These two neural systems make up the autonomic nervous system.

The organization of the autonomic system and its peripheral motor ramifications are diagrammed in Figure 7.16. The two antagonistic divisions are the *sympathetic,* shown in color, and the *parasympathetic,* shown in black. It will be seen that the two systems arise from different regions of the spinal cord. The sympathetic nerves emerge from the thoracic and lumbar divisions of the cord, which make up the long central portion, while the parasympathetic nerves arise from the cranial level, near the brain, and the sacral level, the most pos-

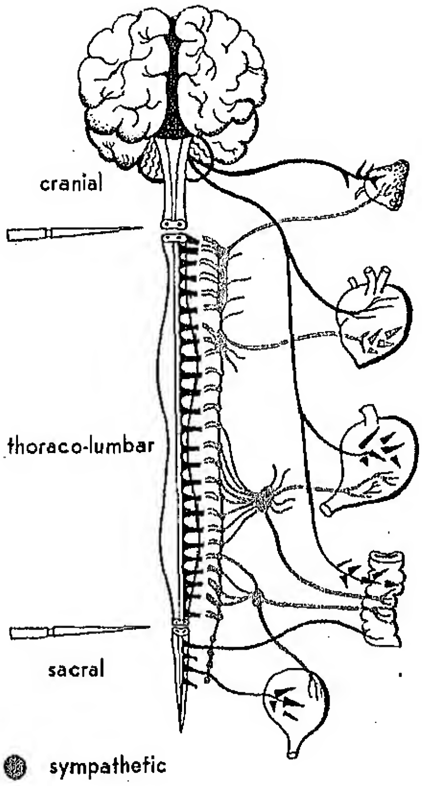


Figure 7.16. The autonomic nervous system. Most internal organs are innervated by both parasympathetic and sympathetic nerves, from the two antagonistic divisions of the autonomic nervous system. Some of the many interconnecting ganglia of these divisions are indicated.

terior section of the spinal cord. Nerves from both the sympathetic and the parasympathetic systems supply the different internal organs of the body. As shown in Figure 7.16, sympathetic nerves emerge from the spinal cord and then enter two chains of ganglia (aggregations of nerve cells) arranged laterally along the cord. Nerves leaving these ganglia go out to all of the major visceral organs. In some cases there are still other sympathetic ganglia, or waystations, located near the bodily organs. The parasympathetic nerves ordinarily enter ganglia close to or within the walls of the organs innervated before connections are made with the organs. The many interconnections provided in the ganglia of the autonomic system help account for the diffuse nature of emotional activation; that is, many organs are activated at the same time. These complex arrangements also mean that visceral reactions are always somewhat slower than the fastest skeletal reactions.

Most of the visceral organs of the body are innervated by both sympathetic and parasympathetic nerves. These two divisions typically have antagonistic effects. For example, stimulation of the vagus nerve, which is a parasympathetic nerve, causes the heart to slow down, while stimulation of the sympathetic nerves to the heart causes it to speed up. Parasympathetic stimulation causes the pupils of the eyes to constrict, while sympathetic stimulation dilates the pupils.

When we are relaxed and in a pleasant mood—that is, when the parasympathetic system is dominant—respiration and blood pressure are normal and the digestive movements of the stomach and intestine proceed optimally. During the excited states, especially in anger or rage, the sympathetic system takes over. Blood pressure rises and the pulse rate quickens. Respiration is interrupted or increased in rate. Digestive processes slow down or stop, and blood is diverted from the visceral organs to the skeletal muscles and brain. Inhibition of the salivary glands causes the mouth to become dry. Stimulation of the sweat glands of the skin increases the amount of perspiration, with a corresponding change in the GSR.

Cannon first pointed out that the sympathetic nervous system is an emergency system, acting to prepare the individual to attack or defend himself in a threatening

situation.[5] One of the most important sympathetic effects from the point of view of emergency action is the secretion of adrenalin by the medulla of the adrenal gland. The presence of this hormone in the blood enhances other sympathetic effects throughout the body. Adrenalin speeds up the heart beat, raises blood pressure, increases blood-sugar level by acting on the glycogen in the liver, and makes the blood clot more quickly. The effects of the sympathetic system and adrenalin acting together mobilize the resources of the body for action. Individuals in highly aroused emotional states sometimes perform feats of strength or daring which would be impossible for them under ordinary circumstances.

It would be convenient if we could classify emotions on the basis of sympathetic or parasympathetic activity; that is, if we could say that certain emotions are sympathetically controlled and certain others parasympathetically controlled. Unfortunately, such an easy classification is not possible. It is probably true that in some highly excited emotional states sympathetic activity is almost completely dominant while parasympathetic activity is at an absolute minimum. The opposite situation is probably true in states of almost complete relaxation. However, most of the emotions which we recognize in ourselves and others —joy, sorrow, excitement, disgust, and many more—apparently have correlated physiological effects resulting from both sympathetic and parasympathetic activity.

In Figure 7.17 we have tried to suggest how different emotions may be based on varying patterns of autonomic control. Varying degrees of sympathetic and parasympathetic activity for different emotions are indicated in the bar graph. We put anger at the top, because in a violent rage the sympathetic system takes over almost completely. At the bottom the state of repose shows the parasympathetic system dominant. Fear is mainly a sympathetic reaction, but sometimes a fearful animal or person will urinate or defecate—reactions that are initiated by parasympathetic stimulation.

In addition to the patterning of emotional reactions based on sympathetic and parasympathetic activity, there is recent evidence to show that the patterns of rage and fear are differentiated on the basis of two different hormones secreted by the adrenal medulla, adrenalin and nor-adrenalin.[7] When nor-adrenalin is secreted, a typical rage pattern results. Adrenalin, on

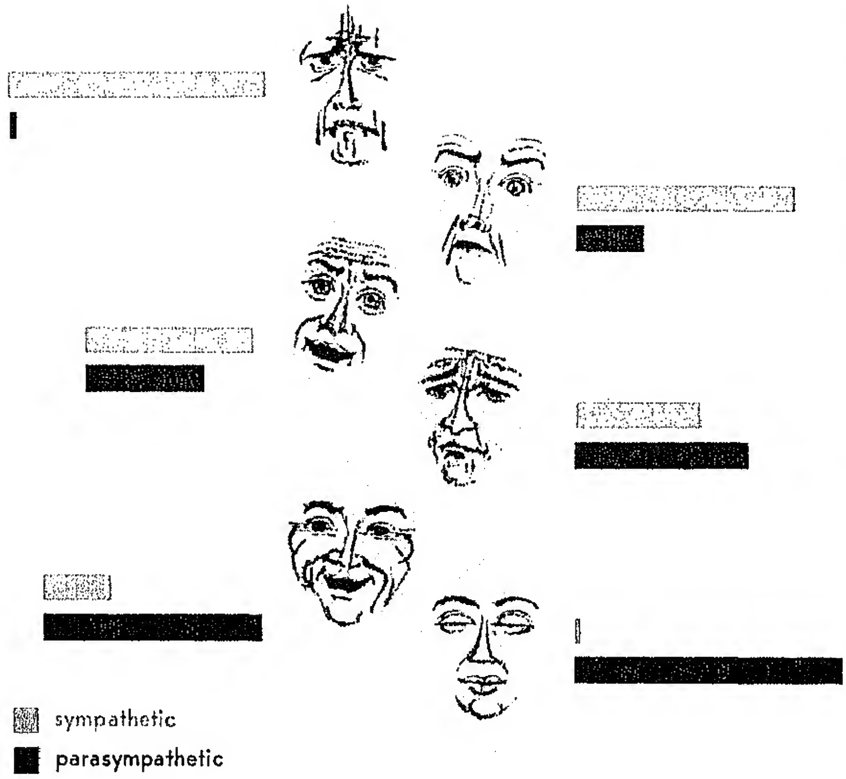


Figure 7.17. Suggested patterns of autonomic activity in emotion. Different emotions are differentiated partly in terms of varying amounts of sympathetic and parasympathetic activity. In anger, the sympathetic system is almost completely dominant; in repose, the parasympathetic takes over. In addition, several kinds of adrenalin account for some variations in emotional patterns.

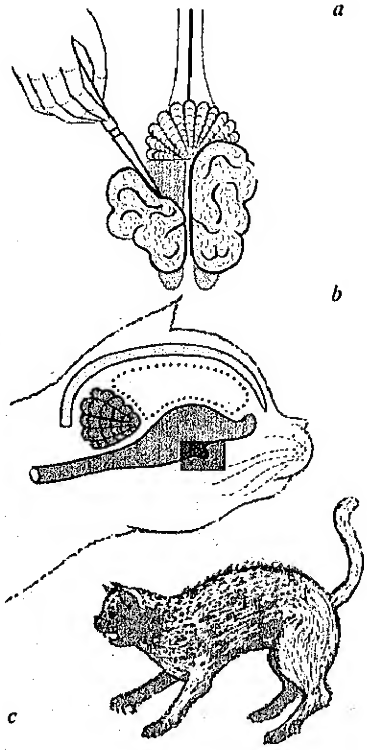


Figure 7.18. Emotion in decorticate cats. Animals with the cortex removed, a, *but with the hypothalamus intact,* b, *show a lower threshold for rage reactions,* c. *The cerebral cortex ordinarily exerts a restraining influence on emotional response.*

the other hand, produces a pattern of fear. Still another hormone in this complex may be responsible for the typical anxiety pattern.

Emotion and the Brain. We have seen how the physiological expression of emotion is regulated by the two divisions of the autonomic nervous system. A further problem is to determine the role of the central nervous system in emotional activity. What are the mechanisms that integrate overt emotional responses with the physiological components? The first definitive studies on the role of the brain in emotion were carried out by Bard and Cannon.[8] Using cats and dogs as subjects, they attempted to determine by surgical means what level or part of the brain is necessary for emotional response. In some animals the cerebral cortex was removed, in others the cortex and thalamus were removed, and in others cuts were made through the brain stem at levels below the hypothalamus.

The procedure used by Bard to study decorticate cats is shown in Figure 7.18. After the cortical covering of the cerebral hemispheres is removed, the cats must be especially cared for since they lack many sensory and motor abilities of the normal animal. However, decorticate cats can be kept alive for long periods of time. Bard found that these animals displayed a lowered threshold for rage; that is, it was much easier to provoke a sharp fighting rage in them than in a normal cat. This so-called "sham rage" is transient, however, and does not lead to the prolonged pattern of adjustive responses that an enraged normal animal displays. Bard concluded that the cerebral cortex normally exerts an inhibiting or restraining effect on emotion. Thus when the cortex has been removed, emotional reaction is more readily provoked.

Further surgical work showed that the fully integrated emotional reaction can be produced in animals without the cortex and thalamus, but only if the hypothalamus is left intact. As we learned in Chapter 4, this area of the brain is a center for neurochemical integration of motivational and emotional activities. It is sensitive to adrenalin and other hormones in the blood stream, and probably manufactures hormones as well. The hypothalamus contains the principal brain centers for the sympathetic and parasympathetic divisions of the autonomic nervous system. If the part of the hypothalamus controlling sympathetic activities is injured, the individual tends to be drowsy, whereas if the parasympathetic centers are injured, chronic insomnia results.

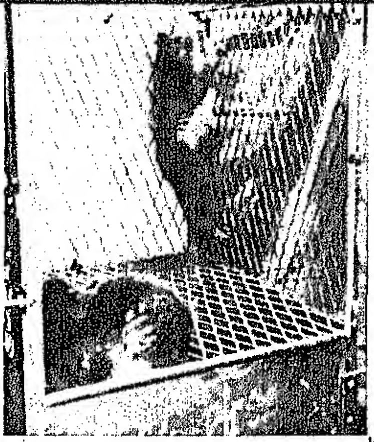
Although the cortex as a whole exerts an inhibitory influence on extreme patterns of emotion, we know from further studies that certain areas of the cortex are important in regulating specific emotional reactions.[9] The photographs in Figure 7.19 illustrate the complete loss of fear reactions in a rhesus monkey after parts of the temporal lobes of its cerebral cortex were removed. When first brought into a laboratory, the rhesus monkey is a very wild animal, displaying marked fear responses to many different stimulus objects. The photographs show the reaction given to a cat (*a*) and cleaning brush (*b*). Following bilateral removal of a part of the temporal lobes, the same monkey reacted to the cat and brush in the manner shown in Figures 7.19*c* and *d*. The animal had absolutely no fear of objects that had terrified it prior to the operation. Otherwise it appeared quite normal after the operation except for heightened sexuality and an in-

creased interest in investigating and manipulating objects.

There are two lines of evidence from human clinical cases that indicate the importance of the cerebral cortex in emotion and in reaction to pain. In certain cases the surgical removal of limited regions of the frontal lobes reduces anxiety and the emotional effects of some types of pain. The individual still feels pain, but it does not distress him. Another line of evidence is based on the effects of a radical operation, called prefrontal lobotomy, upon the emotional status of individuals seriously ill with pain, depression, and anxiety. In this operation the nerves connecting the frontal lobes and the hypothalamus are severed. This radical procedure, which has been rarely used in recent years, gives relief from pathological anxiety or pain but leaves the patient emotionally shallow, with very restricted interests.

Emotional Learning with Brain Stimulation. Earlier, we described emotionally based habits as a third stage in emotional behavior. Although the neurochemical regulation of emotion as we have thus far described it applies mainly to the activation pattern and emotional after-effects, we believe that related physiological activities of the same general nature account for the long-term aspects of emotional habits. Recent experimental studies give concrete support to the belief that emotional learning is defined by neurochemical action within the brain.

An important series of experiments by Delgado, Roberts, and Miller has shown that the emotional disturbance induced by electric stimulation of certain brain areas will motivate learning. It has long been known that direct electric stimulation of



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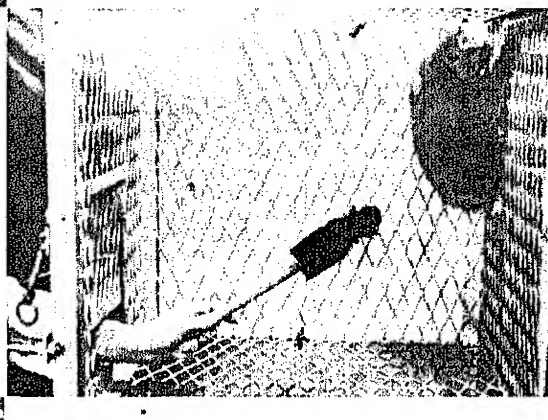

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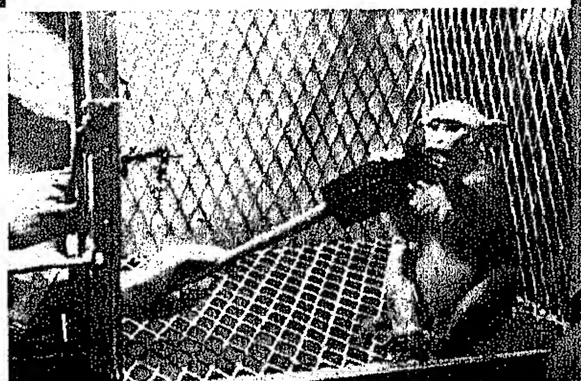


d

Figure 7.19. Effects of temporal lobectomies on fear reactions. Rhesus monkeys are often very wild in laboratories, displaying marked fear reactions to many common objects, a *and* b*. Following removal of parts of their temporal lobes, monkeys lost their fear for the same objects,* c *and* d*.* (Courtesy the late Dr. Paul H. Settlage.)

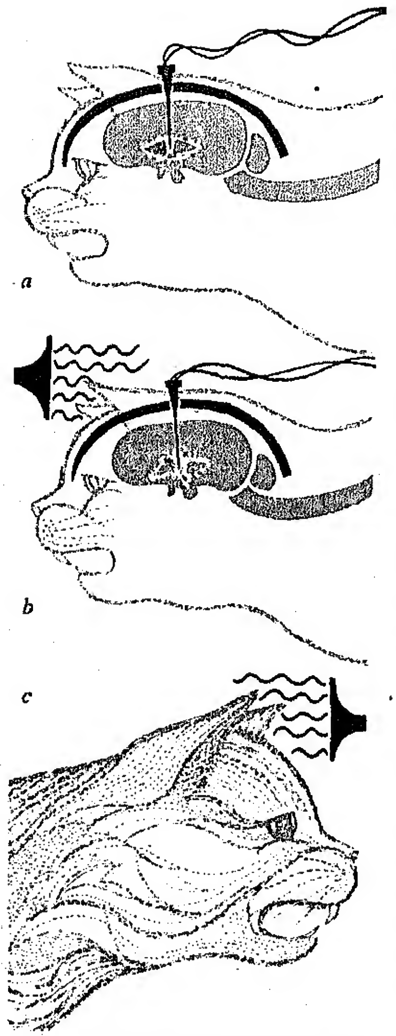


Figure 7.20. Conditioned fear from electric stimulation of the brain. Direct thalamic stimulation produces fearlike responses, a. *When such stimulation was paired with an external stimulus,* b, *conditioned fear reactions and avoidance behavior were learned in response to the stimulus,* c. (Based on Delgado, J. M. R., Roberts, W. W., and Miller, N. E. Learning motivated by electrical stimulation of the brain. *Amer. J. Physiol.*, 1954, 179, 587–593.)

areas in and near the thalamus will produce in an animal a disturbance resembling fear. To investigate whether such stimulation can serve as the basis of conditioning, the experimenters prepared cats with fixed electrodes located in the thalamic area, as shown in Figure 7.20*a*. Very fine needle electrodes can be inserted through the skull and left in the brain indefinitely, with no damage or discomfort to the animal.

The cats used in this study were taught to turn a wheel to escape a painful shock to their feet and then were tested with direct electric stimulation of the brain. The wheel-turning response transferred quickly to this new stimulus situation. Furthermore, external stimuli which previously had elicited no response were conditioned, by pairing them with the shock to the brain (*b*), to induce a fear reaction and consequent wheel turning. Thus, animals learned to respond with fear and escape reactions to the conditioned stimuli, even when the shock to the brain was no longer given (*c*).

In another experiment the cats learned to fear a certain compartment where they had been given electric shocks in the brain, and escaped from it promptly, even when no shock was given. In other words, the fearlike reaction had the motivating properties of an ordinary emotional state, and could be used to establish conditioned responses and other kinds of learning.

These reactions of fear and avoidance could not be elicited by stimulation of the sensorimotor areas of the cortex, but were limited to certain areas in and near the thalamus. A striking new series of experiments by Olds and his associates has shown that electric stimulation of certain other specific areas in the hypothalamus and midbrain constitutes a reward or "pleasure" for the animal. As shown in the x-ray photograph in Figure 7.21*a*, rats were prepared with fixed electrodes as described above. When the electrodes were placed in the specified areas, the rats developed what might be described as an electroneural "addiction."

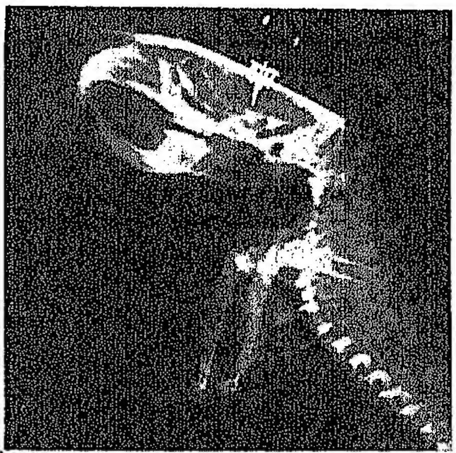
To test a rat in this situation, it is placed in an experimental box containing a lever which, when depressed, stimulates its brain (Fig. 7.21*b*). The first time the rat presses the lever in its random moving about it looks startled, hesitates, and moves more cautiously than before. After several more or less accidental hits on the lever, the animal settles down to steady work, striking the lever repeatedly, as many as five thousand times per hour. A rat with an electrode placement that is highly motivating is like a thing possessed, standing wide-eyed, with one foot on the bar and its head cocked to one side. The tongue licks in and out of the mouth rhythmically as the rat strikes and restrikes the bar. Some rats left in the box for twenty-four hours continued to stimulate their own brains for the entire time, with hardly a pause. Hungry rats would often ignore food if given the opportunity to stimulate themselves in the hypothalamus.

Many studies are in progress on this electroneural habit formation. The same sort of effect has been demonstrated in monkeys. That it is of an emotional nature is indicated by several control observations. For example, if the rat is given the tranquilizing drug, reserpine, that is used to quiet emotional tension, the response stops or slows down temporarily. Further studies have shown that different brain areas produce different effects according to the state of motivation of the animal. Thus with certain electrode placements, an animal re-

sponds more avidly when it is hungry than when it is full. Other specific areas in the brain seem to be associated with thirst and the sexual drive.

Here then is a new chapter in the study of the bodily mechanisms of emotion. The experiments on electroneural conditioning and habit formation open up many new lines of research into the mysteries of emotion and motivation. They demonstrate clearly the close bonds between emotion, motivation, and learning. They show that emotional learning may be a straight-forward, bodily affair devoid of value judgments from the previous experience of the animal or individual. We need to know much more about how bodily conditions—periods of illness, pain or injury, or unavoidable stress—lead to emotional habits such as negativism and antagonism. It seems quite possible that such habits are induced physiologically and only later are organized and rationalized into what we believe to be important human values and attitudes.

a



b

Figure 7.21. "Electroneural addiction" in rats. Rats prepared with a permanent electrode in the brain, as shown by the x-ray photograph, a, *learned to stimulate their own hypothalamus by depressing a lever,* b. *This brain stimulation motivated them to persist in lever pressing at a rapid rate for many hours without respite.* [Photographs from Olds, J. Pleasure centers in the brain. *Sci. Amer.*, 1956, 195 (4), 105–116.]

Theory of Emotion. A general statement of the relationships between internal and external emotional reactions and the correlated neural and chemical processes within the body is at best a tentative effort. Some of the most exciting research in physiological psychology deals with problems of emotion and motivation, and current experimental results have a tendency to outdistance theoretical statements almost as soon as they are made. However, a general summary of what we know about the nature of emotion can be made.

An appreciation of the different kinds of emotional reactions and their persistence and change in time requires an understanding of neurohumoral integration in the response mechanism. We have seen how various emotions are differentiated in part by the two divisions of the autonomic nervous system. In general, the parasympathetic system is dominant during relaxed, undisturbed behavior, while the sympathetic system is dominant during excitement and emergency reactions. The typical patterns of fear, rage, and anxiety are apparently correlated with different components of the hormone complex from the adrenal medulla—adrenalin, nor-adrenalin, and others.

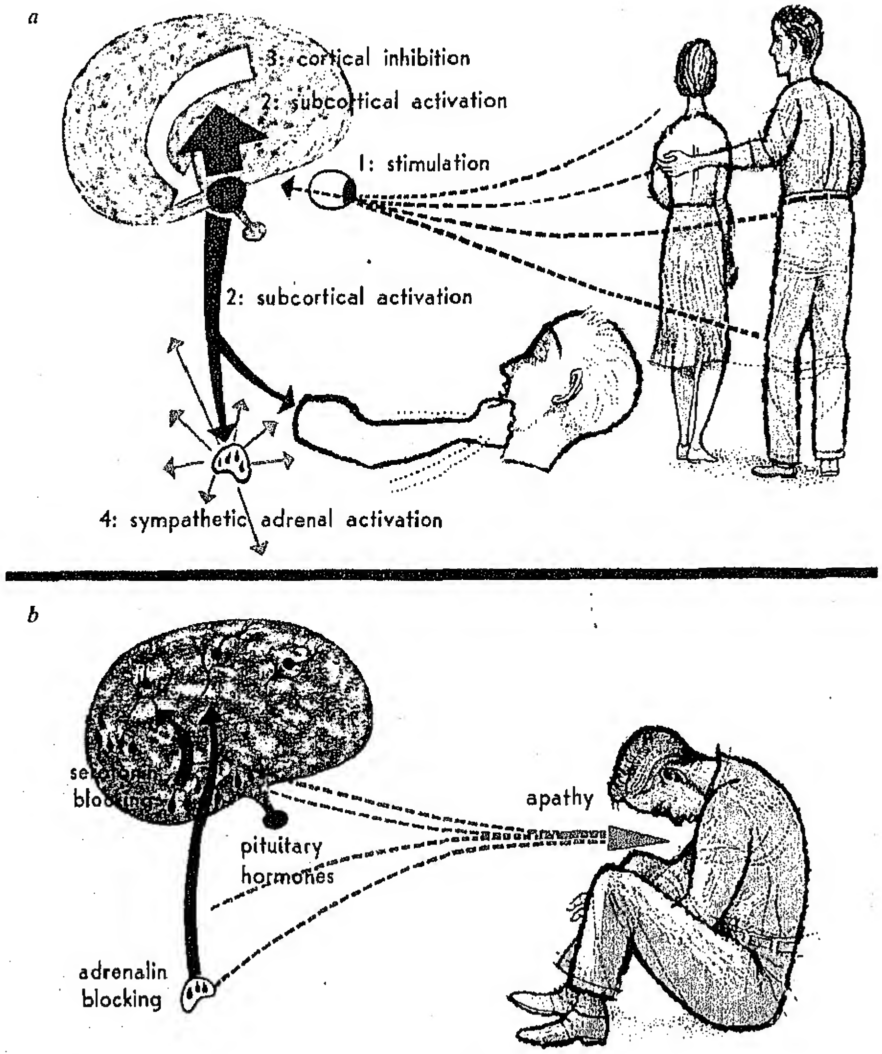


Figure 7.22. Stages in the activation pattern and emotional after-effects. a. *In immediate emotional reactions, sympathetic-adrenal activity may lead to violent or excited behavior, by blocking normal cortical inhibition.* b. *With greater accumulation of adrenalin and serotonin in the system, their synaptic inhibitory effects lead to depression and apathy.*

The activation pattern of fear and rage can be described in four stages of action (Fig. 7.22*a*). First an *emotional stimulus* acts upon the organism. As we have seen, there are some unlearned emotional stimuli, but many more are learned. The second stage is that of *hypothalamic activation,* which in turn sends impulses toward the cortex and also toward the lower systems of the brain, the spinal cord, and the autonomic centers. The third stage involves *cortical inhibition,* which serves to regulate the fear-rage response, or tone it down somewhat. The next stage is that of *autonomic activity,* involving, in the case of fear and rage, a dominance of sympathetic action. One aspect of this autonomic activity is the release of adrenalin into the blood stream, which blocks to some extent the neural action of the higher brain centers and enhances the action of the sympathetic division of the autonomic system. As a behavioral sequence these four stages of the fear-rage pattern occur very rapidly. First the individual is stopped in his tracks by the threat, the insult, or the injury, and then the emotional reaction of rage, fear, or immobilization occurs.

The nature of the neurochemical regulation of the after-effects of emotion is not well known. In Figure 7.22*b* we show two chemical processes which help define the course of these after-effects. Since, as we learned in Chapter 4, adrenalin serves to inhibit synaptic conduction in the nervous system, its first effect in emotion is to block the normal cortical control of behavior and reduce the level of neural integration. This action may be related to the adverse effects of strong emotion on skilled activity, verbal learning, and memory. However, the persisting effect of an excess of adrenalin is a general inhibition of activity, leading to the depression often seen after strong emotional reactions. A related chemical effect is produced by the brain hormone, serotonin, which, like adrenalin, also blocks synaptic conduction. These inhibitory substances produce an initial effect of increased activity because of their blocking of cortical control; but their long-term effect is one of depression.

Other factors also contribute to the course and persistence of emotion. The

nature of the action generated, such as running or fighting, may feed back sensory impulses into the brain and thus alter the after-effects of the original emotional pattern. Moreover, hormones secreted from the pituitary gland may contribute to the events of fatigue and tension after the initial emotional reaction has passed.

The experimental results on electroneural conditioning and habit formation may lead in time to a reformulation of the nature of motivation in a learning situation. Already these studies have emphasized the close connection between emotional reactions and other forms of motivated behavior. The extraordinarily persistent habits that can be set up by direct stimulation of the brain are significant not only for the theory of emotion but also for learning theory.

There are important practical reasons for our understanding of the different aspects of emotions and their bodily relationships. We can learn to control emotions only through an appreciation of their nature, their persisting stages, and their long-term effects. The psychosomatic illnesses and more serious behavior disorders are without doubt related to the effects of persisting emotion in individual adjustment. Because emotional patterns persist in time, because their after-effects go on for days or weeks and serve to motivate our strongest habits, the emotional ravages in our bodies and our lives can occur.

SUMMARY

The three stages of emotional behavior are the activation pattern, or immediate responses, emotional after-effects, and emotional habit patterns. We often call the immediate responses either positive (approach behavior) or negative (avoidance and aggression).

The activation pattern includes both overt activities and physiological changes. Overt expressive patterns develop gradually in childhood and are modified through learning. The emotional reactions of a newborn child cannot be differentiated beyond excitement and quiescence.

Some of the many physiological changes in emotion are used as a basis for lie detection. A lie detector usually measures changes in pulse rate, blood pressure, breathing rate, and the galvanic skin response (GSR). This procedure should be used cautiously, as it is not a completely accurate method of detection.

Brain waves recorded during emotional states show an activation pattern similar to that induced by external stimulation. During emotion, the higher brain centers are activated by neural discharges from the hypothalamus.

Emotional behavior typically involves the whole body, as in the startle reaction given to a sudden stimulus, in the succeeding pattern of fear or rage, or in the emotional faint.

Emotional after-effects may be long-lasting and motivate the individual to learn new responses. Affectional after-effects—relaxation, attachment, and so on—lead to the habits of love, recreational activities, and social attachments. Such negative after-effects as anxiety, depression, or fatigue lead to habits which will alleviate them. Negative after-effects are seen strikingly in the disaster syndrome.

Prolonged emotional disturbance can interfere with normal physiological processes to the point where psychosomatic illness occurs.

Immediate emotional responses and

after-responses not only serve as motives for specific habits, but affect other learning behavior going on at the same time. Stress and anxiety facilitate the conditioning of reflexes tied in with primitive emotional reactions, but interfere with the learning of verbal material or other skills.

Most emotional stimuli are learned according to individual experience. Conditioned fears are very persistent and are not easily unlearned.

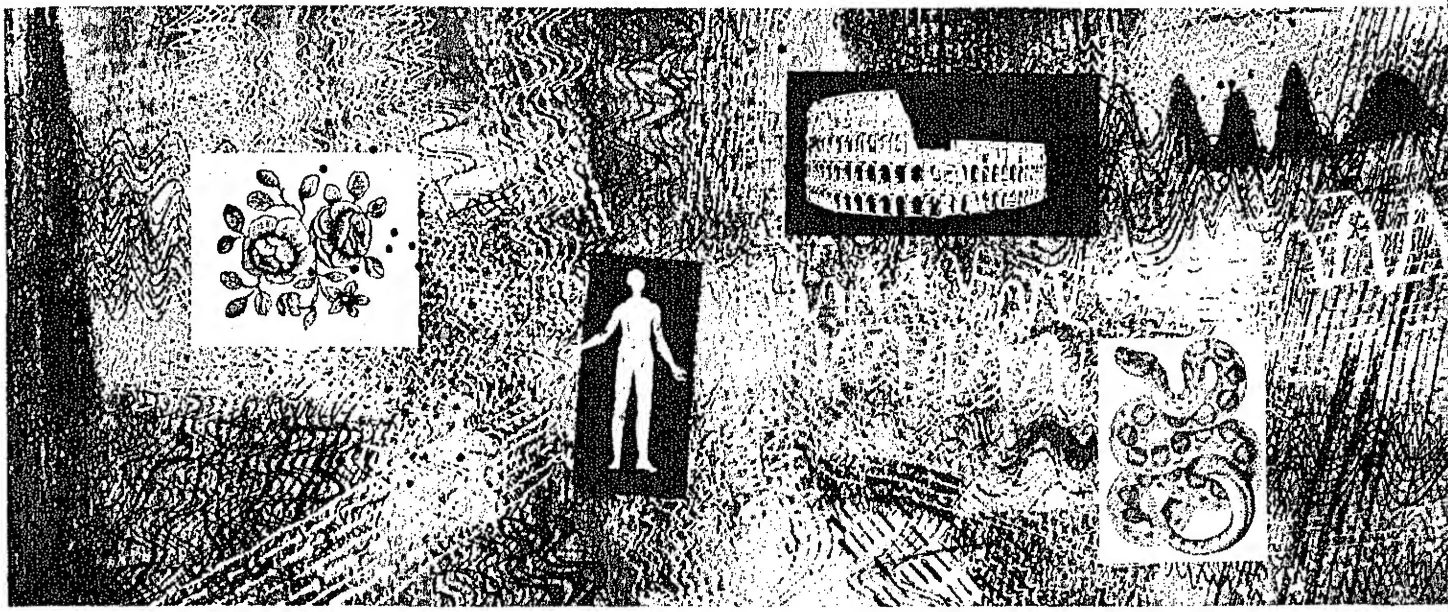
Internal motivational states at times induce emotional reactions and also influence the nature of reactions to external stimuli. The hunger cycle influences expressions of anger, and the female sex cycle has many related emotional changes.

The two divisions of the autonomic nervous system have antagonistic effects in physiological activity. The parasympathetic system is dominant during quiet states, and the sympathetic during marked excitement. The sympathetic system is an emergency system which prepares the individual to attack or defend himself in a threatening situation. Its effects are enhanced by adrenalin.

The hypothalamus is involved in the fear-rage response. Normally the cortex exerts an inhibitory effect on emotional expression. However, destruction of certain areas of the cortical temporal lobes leads to complete loss of fear reactions in monkeys.

Electric stimulation of specific areas in or near the thalamus can serve as punishment, motivating the animal to avoid or escape, while stimulation of certain other areas in or near the hypothalamus serves as a reward, motivating the animal to seek such stimulation. These are demonstrations of emotional learning precisely defined in physiological terms.

Adrenalin and serotonin produce immediate excitement by blocking cortical control, but later their inhibitory effect leads to depression and inactivity. Thus immediate emotional responses and their different after-effects may be due to the persisting action of the same chemical regulators.



CHAPTER 8. PERCEPTION: ITS GENERAL NATURE

The world surrounding each living animal is a varied array of physical forces of great complexity and diversity. Variations in many forms of energy outside the body, from electromagnetic waves to chemical exchanges in the atmosphere, constitute the external environment. Similar energy changes in mechanical pressures, in chemical states, and so on occur inside the living system to create the internal environment of the particular animal.

To this complex physical environment each animal and person responds according to its body structure and present behavior-in-progress. In some animals, such as the simpler invertebrates or the newborn mammal, the ability to observe or perceive the world is very limited. In many adult vertebrates, including the human adult, perception is nearly infinite in detail and complexity. Man's great knowledge about his world is possible through the diversity of ways in which he can perceive the stimulus patterns around him.

The individual's perceptions of the world—what he sees, hears, smells, tastes, touches—are not duplicate copies of the features of the physical environment. The perceived environment is psychological in nature, organized according to the nature of the living system. Our perceptions give us detailed but limited information about the color, form, size, location, distance, and sound of things. A good example of this limited nature of human observation is shown in Figure 8.1. There are three

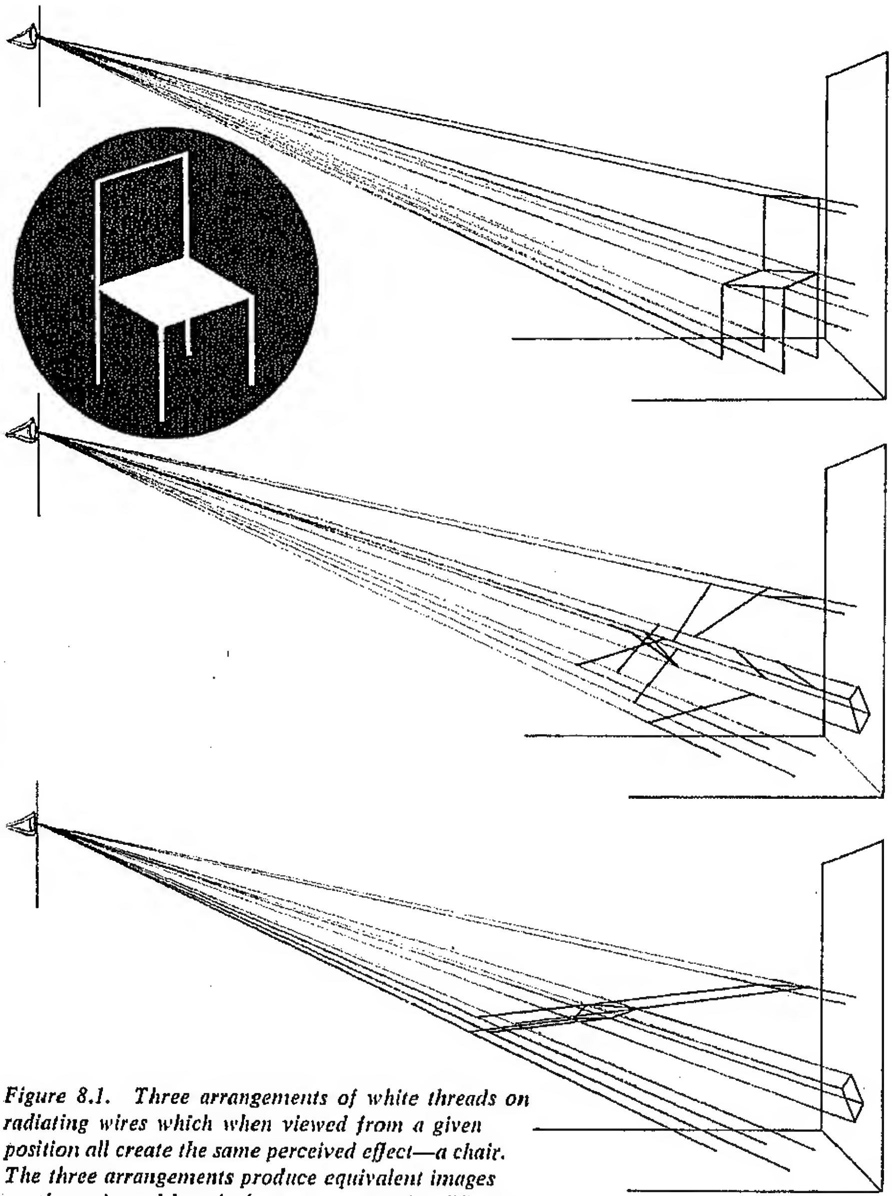


Figure 8.1. Three arrangements of white threads on radiating wires which when viewed from a given position all create the same perceived effect—a chair. The three arrangements produce equivalent images on the retina, although they represent quite different external environmental patterns. (Based on a demonstration described in Ittelson, W. H. *The Ames demonstrations in perception.* Princeton, N. J.: Princeton Univ. Press, 1952.)

arrangements of lines in this figure. The first arrangement represents the limiting rays of light coming from a chair. The two lower arrangements appear rather meaningless, but if you were to observe any one of the three sets of lines from the point of view shown by the position of the eye, you would see a chair in each case. Thus there are many physical arrangements of surfaces and lines in the environment which *could be perceived* as a chair.

The accuracies and inaccuracies of perception, as we shall learn in this chapter, reflect the needs and emotions of the individual and the state of his development and learning, as well as the specific way in which the human organism is constructed to record stimuli and process information from receptors in different parts of the body. Perception is an integral part of the total adjustment of the individual. Motivated activity, learning, and thinking modify our observations of the world, while at the same time our perceptions help define the course of motivation, learning, thinking, and all forms of social behavior.

Types of Perception. Perceptions vary in their nature and complexity. They may involve such varied activities as detecting the faint glimmer of a distant star and judging an artistic display.

Three general types of perception are described in Figure 8.2. The first type is well known to everyone who has ever served as lookout or who has tried to drive a car in a dense fog. The perceptual response in this case is the identification or *detection* of the presence of a stimulus. This type of perception is based on the *absolute sensitivity* of the organism at the time. It is illustrated in Figure 8.2*a* by the dog trailing an odor.

Perceptual *discrimination* is shown in Figure 8.2*b* by the eye differentiating two visual forms. There are countless discriminations of this sort in our everyday behavior. In the simplest kinds of discrimination we differentiate single aspects or properties of perception such as color, shape, size, or weight. In more complex discriminations, such as those involved in comparing foods, clothes, people and their moods, or works of art, we may not know upon what aspects of the physical stimuli we base our judgments.

The girl in Figure 8.2*c* is shown sniffing test tubes. She is trying to put them in order according to the strength of the odor from each tube. Perception of this kind is called *ordering* or *scaling*. When a judge at a beauty contest places the entries in the order of most beautiful, next beautiful, third beautiful, and so on, he is perceptually ordering the contestants. Perceptual ordering involves both detection and discrimination. Without the ability to detect stimuli and to judge differences between them it would not be possible to arrange them on a scale. Stimulus patterns varying in only one way are judged more easily than complex patterns such as musical compositions or people. It is also easier to put things in a simple order than it is to assign absolute values to each item on a scale.

RECEPTORS

The primary function of perceptual activities is to record in a detailed way the occurrences of both general and specific stimuli in the environment. In Chapter 4 we learned something about the different forms of stimuli that activate the organism, and we can summarize the general kinds of stimulating conditions with reference to Figure 8.3. General sources of stimulation such as gravity, barometric pressure, humidity, heat, and the presence of oxygen sustain the vital functions of the body. Any change in these conditions beyond certain narrow limits motivates the individual to re-establish more favorable conditions. General forms of stimulation activate receptors inside the body, but are not spe-

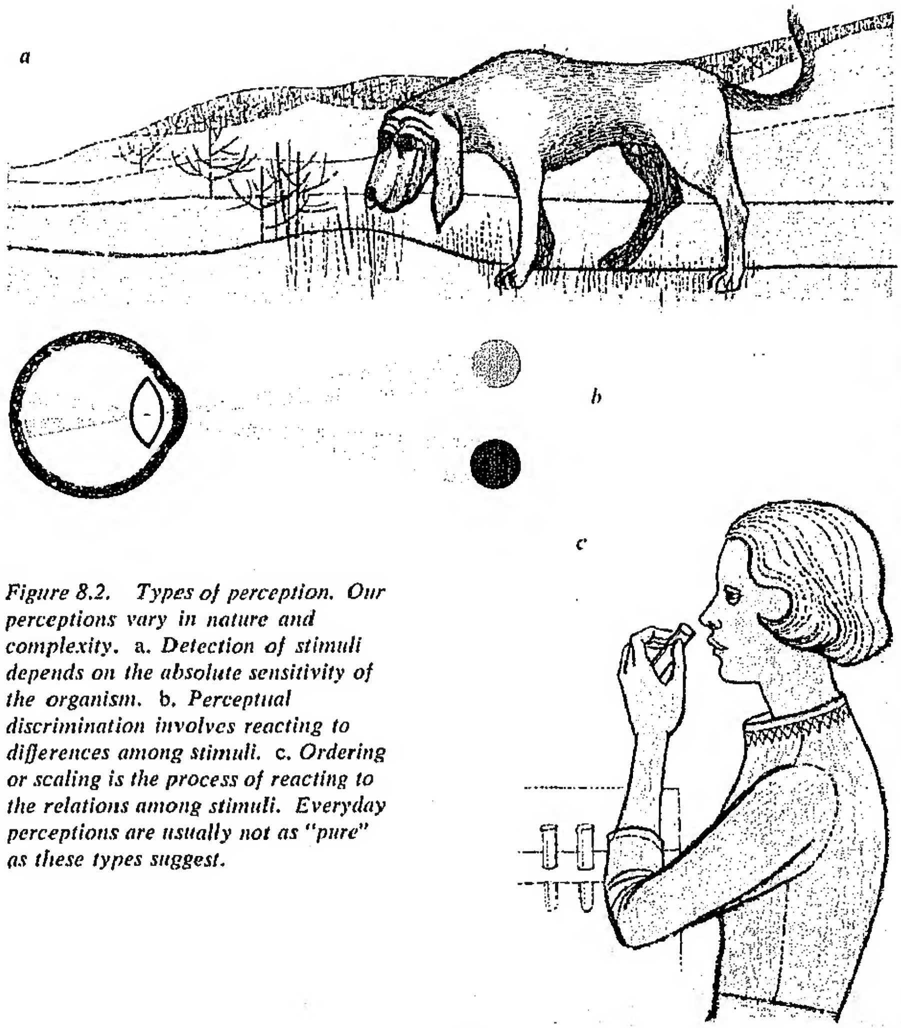


Figure 8.2. Types of perception. Our perceptions vary in nature and complexity. a. *Detection of stimuli depends on the absolute sensitivity of the organism.* b. *Perceptual discrimination involves reacting to differences among stimuli.* c. *Ordering or scaling is the process of reacting to the relations among stimuli. Everyday perceptions are usually not as "pure" as these types suggest.*

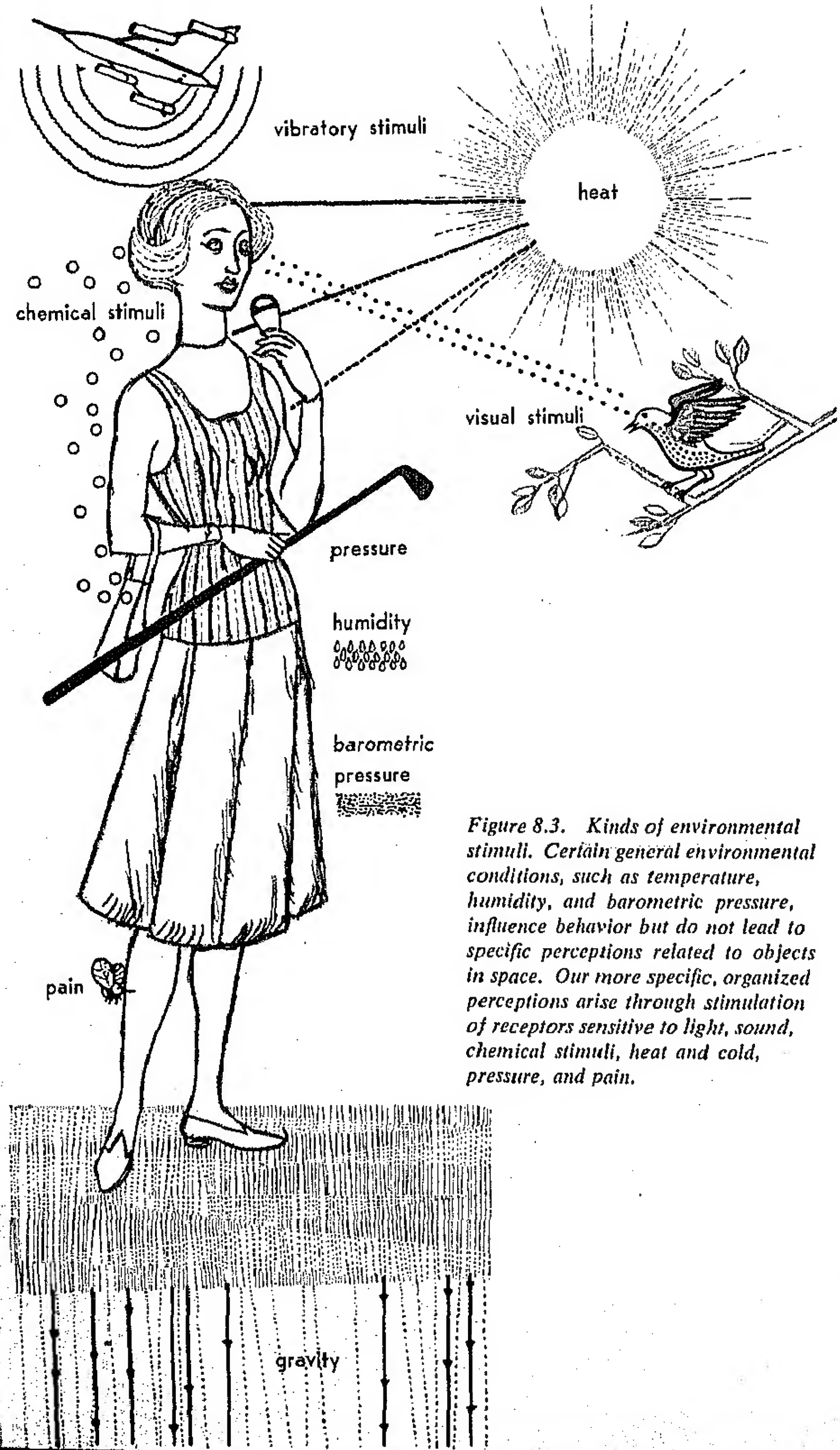


Figure 8.3. Kinds of environmental stimuli. Certain general environmental conditions, such as temperature, humidity, and barometric pressure, influence behavior but do not lead to specific perceptions related to objects in space. Our more specific, organized perceptions arise through stimulation of receptors sensitive to light, sound, chemical stimuli, heat and cold, pressure, and pain.

cifically perceived with relation to objects in space.

Our more specific, organized perceptions involve stimulation of highly developed receptor systems sensitive to visual, auditory, pressure, pain, chemical, and temperature stimuli (temperature stimuli can be either general or specific). Some kinds of receptors are among the most sensitive recording devices known. The eye, for example, can see amounts of light under low illumination that can be recorded by physical apparatus of only the greatest sensitivity. The olfactory receptors of the nose are even more sensitive. One particularly odorous substance, mercaptan, for example, can be detected in concentrations of 0.00000004 milligrams per liter of air. Our first task in understanding perception is to learn about the receptors as recording and analyzing systems for stimulus energies.

Visual Receptors. Visual perception provides our most detailed observations of the environment. On the basis of the activity of the visual receptors, we perceive colors, light and shade, form, pattern, movement, space, and distance. The eye is an exteroceptor which is sensitive primarily to light rays of different wavelengths.

The human eye, shown in Figure 8.4, can be compared in some limited respects to a color camera; that is, it consists of an *iris* which acts as a diaphragm, a *lens*, and a sensitive surface, the *retina*, which is stimulated by the action of light. The size of the opening at the front is controlled by the iris. This opening gets smaller when light is intense and enlarges as illumination decreases. Behind the iris is the lens, yellowish and transparent, which controls the focusing of the light rays in relation to the

rear interior surface of the eye—the retina.

The cut out portion of Figure 8.4*a* shows the front surface of the retina in color with the system of blood vessels superimposed. This complex system of minute blood vessels lies *in front of* the actual visual receptors, which are embedded in a deeper layer of the retina. Light must pass through this network of vessels before the receptors are stimulated. The small spot located at the center of the inverted image of the tree is called the *fovea,* and is the area of most acute vision. When the eye *fixates* on an object, the image of the object falls on the fovea because it is approximately at the center of the optical axis of the eye.

To get some idea of the position and organization of the true receptors for vision, imagine the eye being cut down the middle on a vertical plane, front to back. At the back edge of the cut surface you would see something like the cross section shown in Figure 8.4*b*. The tiny rod and conelike elements are the two types of visual receptors. The rods are more numerous, numbering perhaps as many as 100,000,000 in a single eye. The 6,000,000 or so cones occur in greatest concentrations at the fovea, and in decreasing numbers farther out. They are not found at the periphery of the retina. The rods are not found in the fovea itself but are distributed throughout the rest of the retina. They are most dense a short distance from the fovea. As shown in Figure 8.4*b*, each cone usually has a separate nerve supply; that is, for a single cone there is a single nerve fiber that leads from it into the optic nerve. The rods, on the other hand, are supplied in groups, with one nerve fiber serving a number of rods.

In the drawing of the eye in Figure 8.4*a*, notice a white spot on the retina where

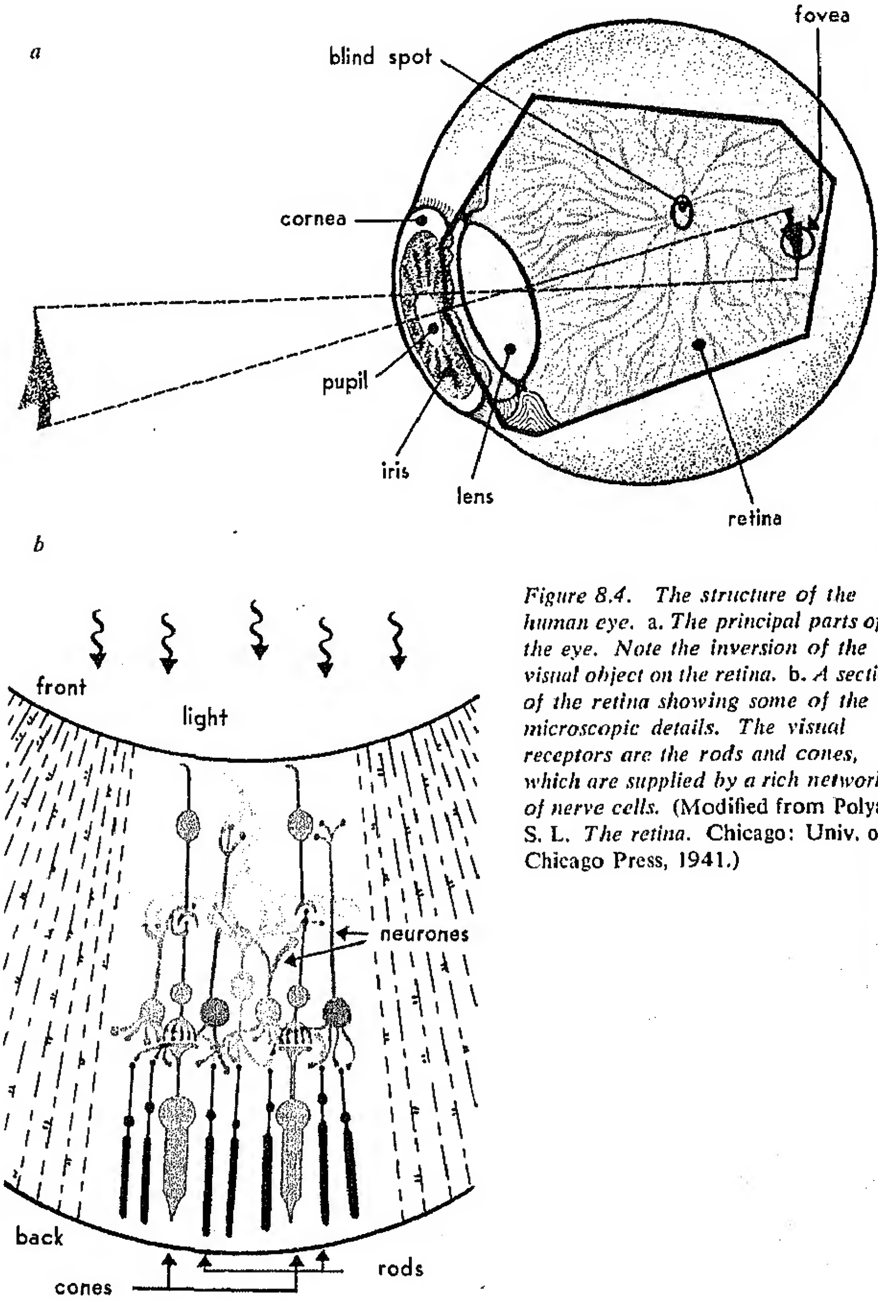


Figure 8.4. The structure of the human eye. a. *The principal parts of the eye. Note the inversion of the visual object on the retina.* b. *A section of the retina showing some of the microscopic details. The visual receptors are the rods and cones, which are supplied by a rich network of nerve cells.* (Modified from Polyak, S. L. *The retina.* Chicago: Univ. of Chicago Press, 1941.)

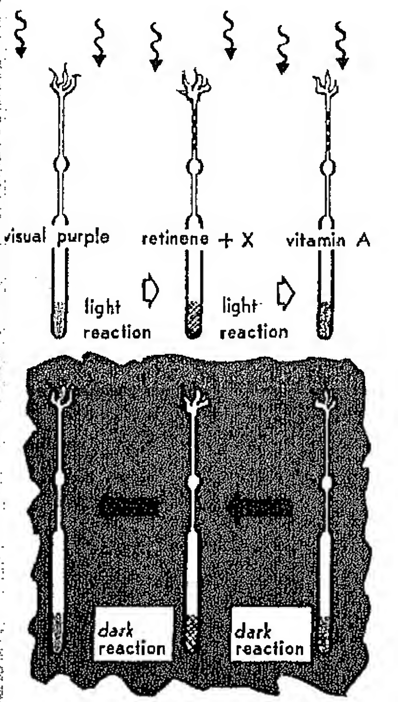


Figure 8.5. The eye as a chemical system. Each visual receptor contains substances that decompose in the presence of light and regenerate in darkness. In the rods, rhodopsin, or visual purple, decomposes to form retinene and Vitamin A, triggering nerve impulses in the process. In darkness, Vitamin A and other materials from the blood recombine to form rhodopsin. Not much is known about the photochemistry of the cones.

the blood vessels and optic fibers converge and leave the eye. Since this part of the retina has no rods or cones, it cannot react to light and thus produces a *blind spot* in the visual field. Every eye has its blind spot, but only under special conditions of observation can it be detected. You can observe your visual blind spot by holding a pencil in your left hand, point up, about 15 inches directly in front of your right eye. Close your left eye. Now take a small coin and hold it between the thumb and index finger of the right hand with the face of the coin toward you. With the pencil and coin at the same distance, look steadily at the tip of the pencil while you slowly move the coin toward the right. When the coin is about 3 inches from the pencil you will not see the coin, although the fingers holding it will be visible. The size of the blind spot is about the size of a penny at a distance of 15 inches. At greater distances the visual size of the blind spot is correspondingly larger.

The two types of visual receptors play distinctive roles in seeing. The cones respond to bright light and are the receptors that enable us to distinguish hues. The rods respond to lower levels of illumination and do not produce the perception of hue.

Duplexity theory. The duplicity theory or *duplexity theory* of vision refers to the fact that our vision is based on two types of receptors. Many facts about the two-receptor system of vision are firmly established, although there are many gaps in our knowledge of the functions of the cones and color vision. Much more is known about the rods and their function.

Receptor activity in vision is a complicated photochemical process, or a change in chemical state due to the action of light. As diagrammed in Figure 8.5, when light acts on the rods, a chemical substance in them is changed, leading to the formation of other chemical substances and then to the activation of the nerve fibers attached to the rods. Presumably the cones are stimulated in much the same way.

The photochemical activity of the rods and cones helps explain an important aspect of vision which is known as visual adaptation. Everyone is familiar with the experience of entering a theater or similar dark place and not being able to see well for the first few minutes. After a short time, however, details become visible. This increased sensitivity is the result of *dark adaptation,* a manifestation of the photochemical changes in the visual receptors that take place when going from light to dark. Our eyes adapt to the level of illumination to which they are exposed. Dark adaptation is complete and the visual receptors are most sensitive after approximately forty minutes in complete darkness. During World War II night lookouts and other personnel whose duties required acute vision in dim illumination were required to dark-adapt their eyes for a half hour or so before going on duty. They would either remain in a dark room for this period or wear red goggles, since red light stimulates the rods less than any other color. After a period of wearing red goggles a lookout's eyes would be in condition to detect extremely dim light.

If the eyes are dark adapted, an abrupt return to daylight or a high level of illumination results in a temporary "blinding." After *light adaptation* has taken place, however, vision again becomes normal. Ordinarily the process of light adaptation is a very rapid one compared to dark adaptation and requires only a few minutes at most.

Dark adaptation involves an increase in sensitivity due to the absence of stimulation, while light adaptation is a loss in sensitivity during stimulation. If a receptor cell is stimulated continuously, it loses its ability to react. Ordinarily our eyes move frequently and thus the visual receptors do not adapt completely; but complete loss of sensitivity can be demonstrated with special techniques. The optical arrangement in Figure 8.6 accomplishes something that the eyes can never do, and that is to keep a visual stimulus focused on exactly the same spot continuously. A small mirror is mounted on a contact lens on the right eye of the subject. A beam of light from a light source, shown at the far left, is reflected from the mirror on the eye to a screen in front of the eye. The reflection of the beam from this screen is directed into the eye by a special optical system. The effect of this arrangement is to direct the beam of light to the same area of the retina, no matter how the eye moves. If the same spot is continuously stimulated, it ceases to react to the light after a few seconds. Later we shall describe adaptation effects in other kinds of receptors.

Some people are bothered by the fact that the optical system of the eye inverts the retinal image, as shown in Figure 8.4*a*, and believe that this inverted image is reinverted by the brain so that we perceive the world upright. In order to achieve some understanding of this problem of orientation of visual space, we must think of the perception of space as a relative matter. Up is up because through learning and the coordinated activities of our bodies we have developed a system of spatial references which have meaning only in relation to each other. An individual does not perceive his own retinal image. This image is only the initial locus of stimulation, the end result of which is the perceptual response.

If it were possible to invert the visual field of a baby at birth without distorting this field, there is little doubt that the child would adjust very adequately to this changed set of visual directions. According to evidence from a series of experiments which we shall describe later, we are fairly certain that the child would not perceive discrepancies of direction between what he sees and what he hears or feels. In other words, his changed visual world would stabilize and be perceived as having a normal appearance of up and down with respect to all the other factors—kinesthetic, cutaneous, vestibular, and auditory—that give him knowledge of direction. The Innsbruck studies described in Chapter 1 showed that even an adult adjusts fairly well to a reversed visual field.

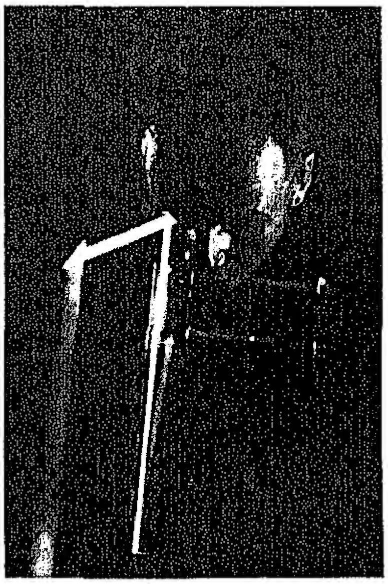


Figure 8.6. Demonstration of complete light adaptation of visual receptors. The optical arrangement directs a restricted beam of light to the same area of the retina, no matter how the eye moves. Under such conditions, the continuously stimulated visual receptors cease to react to light in a few seconds. (Riggs, L. A., Ratliff, F., Cornsweet, J. C., and Cornsweet, T. N. The disappearance of steadily fixated test objects. *J. opt. Soc. Amer.*, 1953, 43, 495-501; photograph courtesy Black Star.)

Auditory Receptors. Our auditory receptors provide the means by which we perceive noise, tones, music, and their location and movement in space. The receptors of hearing are found in the inner ear, which is located in a bony cavity of the head.

The energy that constitutes the world of sound is described as a kind of wave, which may be either pure or complex (Fig. 8.7). Pure sound waves are produced only under laboratory conditions with very special equipment. The sounds we hear in the everyday world are always complex. Sound is produced by the vibration of physical objects such as a taut string or a bell. During vibration, an object imparts some of its energy to the surrounding air, causing the air particles to move in a vibratory pattern like that present in the object itself. The agitation of the air particles consists of a series of alternate regions of

Figure 8.7. Pure and complex sound waves. Sound is described as wave motion with particular frequencies and amplitudes. The top two waves are pure tones, represented by sine waves. All complex wave motions, such as the sound of the human voice, can be analyzed into component sine waves.

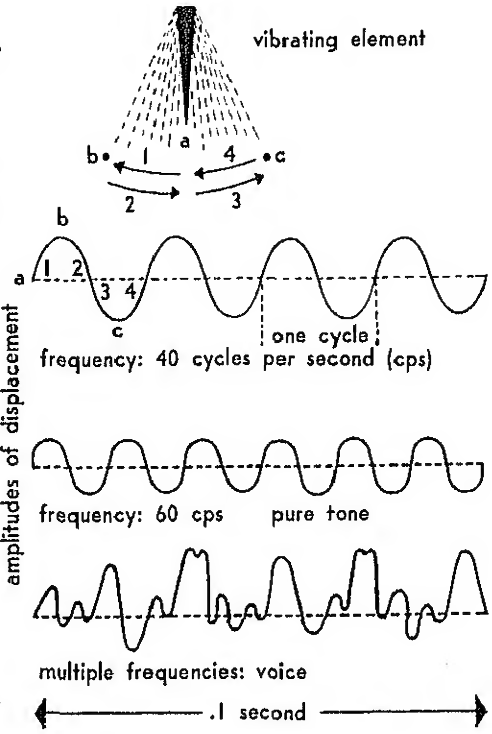
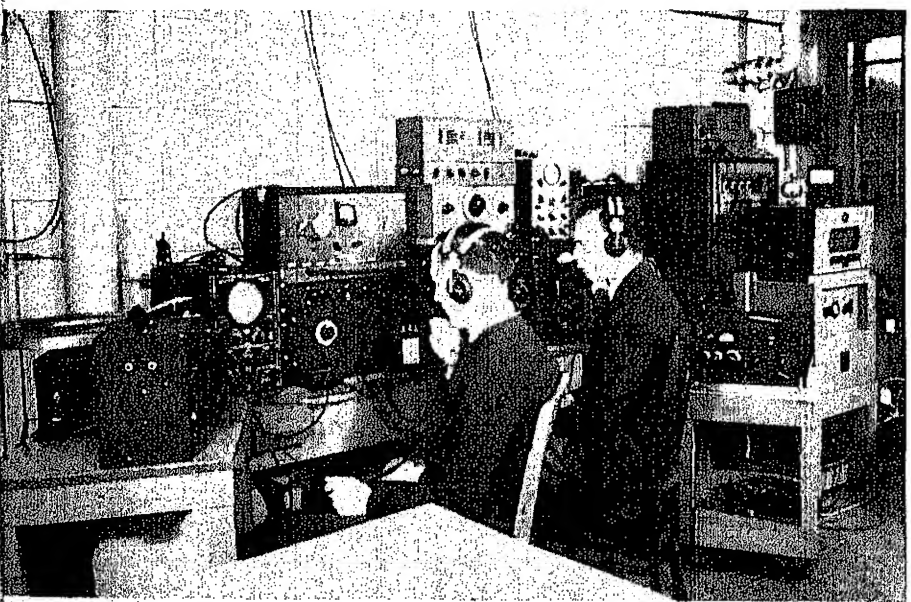


Figure 8.8. A modern hearing laboratory. Research on hearing requires elaborate electronic equipment for the measurement and control of sound. (Courtesy Psycho-Acoustic Laboratory, Harvard University.)



condensation and rarefaction—that is, alternate changes of density. It is the progression of the pattern of changing pressures through a medium that we call the sound wave. In its uncomplicated form a sound wave is described as simple harmonic motion, portrayed visually by a sine curve, such as the first two curves in Figure 8.7. One rarefaction and one condensation constitute a single cycle.

There are three main physical properties of a sound wave. The amplitude of displacement or the height of the curve is related to the *intensity* or amount of energy in the wave. The *frequency* of the wave is determined by the number of full cycles appearing every second. If, for example, twenty full cycles occur each second, the frequency of the sound wave is said to be twenty cycles per second (20 cps). The third important physical property of sound is the wave complexity, which refers to the combination of waves of different frequencies and intensities into a single pattern. The third wave in Figure 8.7 represents a pattern of speech sounds.

The discrimination of the different physical properties of sound waves gives us perceptions of the psychological phenomena of *pitch, loudness,* and *quality* or *timbre* of sounds. Pitch of sounds is closely related to the frequency of the sound wave. As the frequency increases, the pitch of the perceived sound becomes higher. Loudness depends on the intensity of a sound, although perceived loudness is also affected by frequency. Timbre depends on the complexity of a sound wave, and defines the special and distinctive quality of the many things we hear. The difference between middle C when played on the piano and the French horn is due to the timbre of the sounds.

Modern scientific research on hearing depends upon rigorous measurement and control of the sound source. As shown in Figure 8.8, a hearing laboratory is a soundproofed room containing complicated electronic equipment for generating and recording sounds of known frequency and intensity.

The ear is the *organ* of hearing, not the receptor. Figure 8.9*a* shows the structural relationships of the parts of the ear. The *eardrum* is a membrane at the end of the external auditory canal. Notice the location of the three bones of the middle ear, the *oval window,* and the snail-like structure called the *cochlea.* The actual receptors of hearing are located in the cochlea, which is filled with fluids. The band running throughout its length, the *basilar membrane,* gets wider as it proceeds up the coil of the cochlea. The basilar membrane and the thin bony shelf to which it is attached divide the cochlea into two main canals which meet and are joined by a small opening at the top of the cochlea called the *helicotrema.*

If we were to cut the cochlea down the middle we would expose a cross section which would look something like the drawing in Figure 8.9*b*. The coiling cavern of the cochlea is seen in this figure. The auditory nerve is shown leaving the cochlea through a bony canal. Fibers of this nerve originate around the receptor cells located on the basilar membrane. In this figure the changing size of the cochlea at different levels of the coiling cavity can be seen.

Figure 8.9*c* shows a greatly enlarged portion of a cross section of the cochlear canal. This figure gives us a view of the true receptors for hearing: the *hair cells* on the basilar membrane. These cells are seen located under the canopylike mem-

a

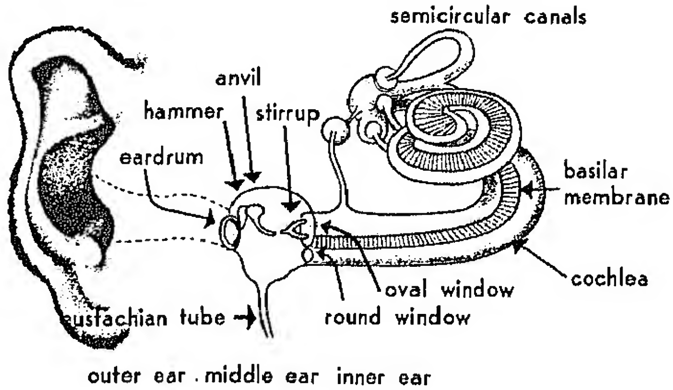
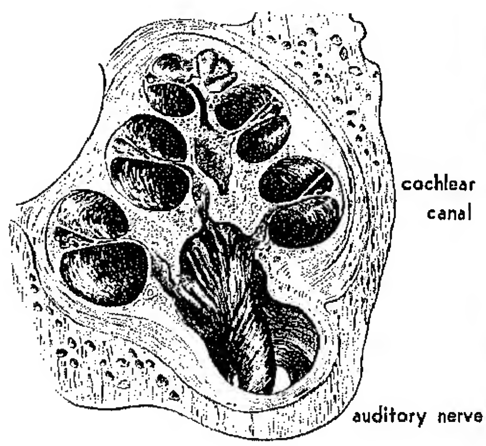


Figure 8.9. The structure of the ear. a. *The major parts of the human ear.* b. *A cross-section through the cochlea.* (Redrawn from drawing by Max Brödel, by permission of the Dept. of Art as Applied to Medicine, The Johns Hopkins Univ. School of Medicine.) c. *Cross-section of the cochlear duct, showing the actual receptors for hearing, the hair cells.* (Modified from Held, H. Receptionsorgane. In Bethe, A. *Handbuch der normalen und pathologischen Physiologie.* Vol. 2. Berlin: Julius Springer, 1926. Pp. 467–534.)



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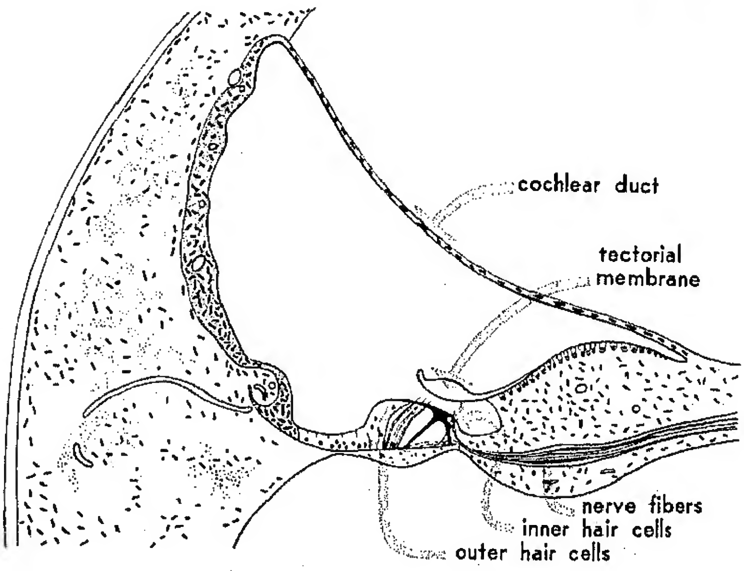

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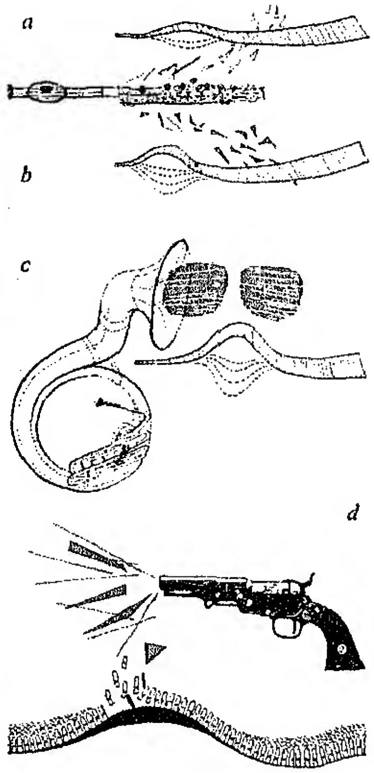


Figure 8.10. Some basilar membrane effects. Different sound stimuli affect the basilar membrane in different ways. Weak sounds produce movements of lower amplitude, a, *than more intense sound,* b. *High frequencies set up movements near the base of the membrane,* b, *while low frequencies set up movements near the apex,* c. *A very intense sound may cause stimulation deafness by throwing hair cells off the membrane,* d.

brane in the middle of the canal. Along with their supporting structures, the hair cells make up the *organ of Corti*. Unlike the receptor cells for vision, all of the auditory receptor cells look much alike.

Sound waves entering the external auditory canal set up vibrations of the eardrum which in turn cause the three bones of the middle ear to move like a piston. The third bone, the *stirrup*, moves back and forth against the oval window, setting in motion the fluids of the cochlea. Movements of the fluids of the cochlea and of the basilar membrane stimulate the hair cells, activating the fibers of the auditory nerve. Nerve impulses in these fibers leading from the cochlea to the brain underlie the perception of sound.

There is still a mystery concerning exactly how movements of fluids in the cochlea are converted to nerve impulses. We do know, however, that movements of the fluids are related to various movements along the length of the basilar membrane. Apparently, different frequencies and intensities of sound affect this membrane in different ways and in different places. Figure 8.10 illustrates a number of basilar membrane effects.

The difference in action of a weak and an intense tone of high pitch is illustrated in Figures 8.10*a* and *b*. A high tone sets up a vibration or change in the basilar membrane near the base of the cochlea where the membrane is narrow. A tone of weak intensity produces a movement of low amplitude in the membrane, whereas a tone of greater intensity initiates a movement of greater amplitude. The difference in movement of the basilar membrane in response to a tone of high frequency and one of low frequency may be seen by comparing Figures 8.10*b* and *c*. A high frequency tone—one which is perceived as having a high pitch—sets up movement of the membrane near the base of the cochlea. In contrast, a low tone causes movement of the membrane nearer the apex of the cochlea, which spreads over a much larger area of the membrane. Sounds of explosive intensity can cause temporary or permanent *stimulation deafness*. Permanent deafness of this sort apparently is the result of the receptor cells being thrown off the basilar membrane by the intense effects of the sound (Fig. 8.10*d*).

Theory of hearing. One of the main theoretical problems of hearing deals with the question of how the ear analyzes sound frequencies—that is, how we discriminate pitch. One theory of hearing, the *place theory*, assumes that specific frequencies of tone cause vibration of particular parts of the basilar membrane, as just illustrated in Figure 8.10. The theory also assumes that perceived pitch is determined by the place of vibration of the basilar membrane and by activity of specific nerve fibers arising from a given portion of the organ of Corti.[1]

Certain observations on hearing have suggested other ideas about the ear as a device for analyzing frequencies of sound waves.[2] If electrodes are placed on the auditory nerve in animals, the electric activity of the nerve fibers can be amplified and recorded. Now if sounds are presented to the animal's ear, the frequency of nerve impulses picked up from the nerve follows the frequency of the sound up to about 4000-5000 cps. An interesting demonstration of this effect can be made by attaching the electronic recorder which is picking up the neural response to an ordinary loudspeaker. If a person speaks into the animal's ear, the electric activity of the auditory nerve reproduces the speech faithfully

enough so that the words can be identified.

Since a single auditory nerve fiber cannot "fire" at a frequency greater than approximately 800 cps, how can we account for the fact that the auditory nerve as a whole can reproduce frequencies up to 4000 cps? The best explanation is that the nerve fibers in the nerve work together according to the *volley principle;* that is, a group of fibers responds in a coordinated way so that the combined total effect is synchronized with the frequency of the stimulus sound. Figure 8.11 shows how a group of fibers responding on the volley principle could keep in step with the frequency of the stimulus. These two drawings represent the action of two sounds of the same frequency but of different intensity. In Figure 8.11*a* we see a tone of low intensity setting up activity in the basilar membrane, which induces a nerve response of the same frequency as the stimulus. The four nerve fibers shown here are responding one at a time, and their *combined* response frequency is the same as the frequency of the sound stimulus. Now if the same tone is repeated at a greater intensity, we have the situation shown in Figure 8.11*b*. Whereas one of the group of four fibers responded to each cycle of the weak tone, two fibers respond to each cycle of the intense tone. The *frequency* of the combined neural discharge is the same in each case, but the *total* neural activity is greater for the intense tone.

We have said that the total electric activity of the auditory nerve can reproduce sound frequencies up to about 4000-5000 cps. Yet the human ear can discriminate sounds up to 15,000-20,000 cps. Obviously the volley principle is not adequate to explain how we hear very high-pitched tones. The best evidence indicates that the ear signals the higher frequencies in terms of the place on the basilar membrane which responds. The most widely accepted theory of hearing today is a combination of the frequency theory and the place theory. We hear low tones by means of frequency representation in the nerve impulse, high tones by means of place representation on the basilar membrane, and, for a wide range of intermediate tones, both types of representation apparently operate in a combined fashion.

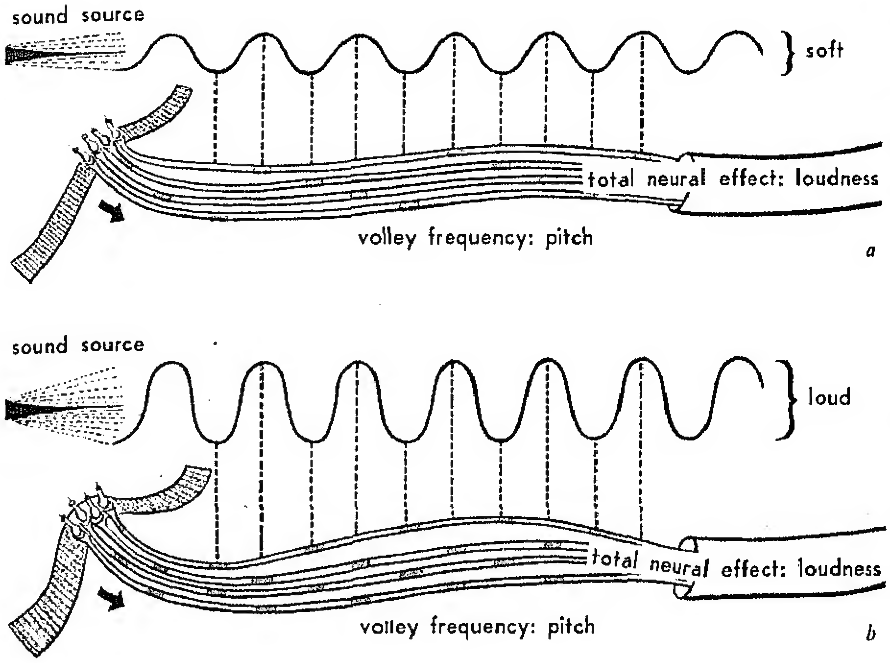


Figure 8.11. The volley principle in hearing. Frequencies up to about 800 cps can be reproduced in individual auditory fibers, while frequencies up to about 5000 cps can be represented by groups of fibers sending impulses in volleys. Very high frequencies are signaled by the place on the basilar membrane stimulated. Loudness depends upon the total number of impulses. (See Wever, E. G. *Theory of hearing.* New York: Wiley, 1949.)

Vestibular Receptors. The inner ear contains a receptor system which makes possible our perceptions of equilibrium, including our reactions to gravity and to acceleration and deceleration of the body. This nonauditory part of the inner ear is called the *vestibular labyrinth* because it is

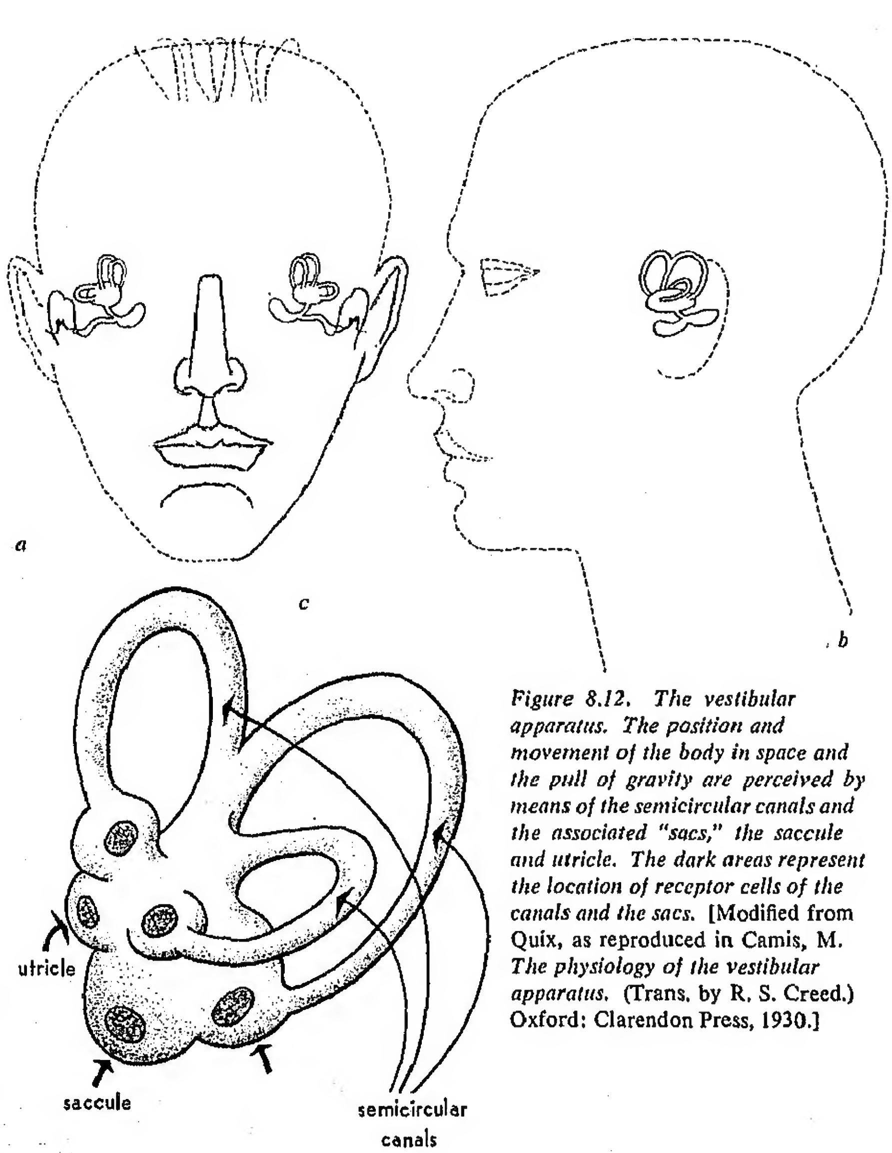


Figure 8.12. The vestibular apparatus. The position and movement of the body in space and the pull of gravity are perceived by means of the semicircular canals and the associated "sacs," the saccule and utricle. The dark areas represent the location of receptor cells of the canals and the sacs. [Modified from Quix, as reproduced in Camis, M. *The physiology of the vestibular apparatus.* (Trans. by R. S. Creed.) Oxford: Clarendon Press, 1930.]

encased in a vestibule off the main cavity of the inner ear. This receptor system can be seen in Figure 8.9*a* behind and to the left of the cochlea.

The structural relationships of the vestibular receptor system are shown in Figure 8.12. It is composed of two main parts: the *semicircular canals,* and a basal part including the *utricle* and *saccule,* all of which are filled with watery fluids. Figures 8.12*a* and *b* show these labyrinths located in the head. In these drawings the structures are greatly exaggerated in size. Figure 8.12*c* shows a more detailed drawing of one set of canals. It will be noticed that the semicircular canals are located roughly at right angles to each other in three planes. The actual vestibular receptors are hair cells located near the base of each canal and in the utricle and saccule. These hair cells extend into the gelatinous lining of the vestibular system, and are stimulated by movements of the fluids or gravitational pull. The angular arrangement of the canals is such that movement of the head in any direction can be detected.

The vestibular receptors are not stimulated by movement of the body at a constant velocity, but by accelerating or decelerating motion. It is only when the rate of motion is changing that the fluids of the labyrinths are disturbed. This fact can be demonstrated by placing a blindfolded person in a noiseless rotating chair in which the speed of rotation can be accurately controlled. The person can perceive motion only when the chair is gaining or losing speed. If the rate of rotation is held constant for a time, the person will have no perception of movement.

Kinesthetic Receptors. *Kinesthetic receptors* are small, relatively simple receptors

embedded in and around muscles, tendons, and joints. Figure 8.13 shows an arrangement of muscle fibers in which two types of kinesthetic receptors are located. One is a tendon receptor and the other is a spiral type of bundle around a muscle fiber. Similar receptors located in connective tissue of the joints are also called kinesthetic receptors.

These receptors are less obvious than exteroceptors, but perhaps the most important of all to our general patterns of behavior. We can get along without vision, without hearing, and without most of the other types of perceptions, but organized human activity of any type is unthinkable without the regulatory activity of kinesthetic receptors. From the execution of the simplest kind of movement to the mastery of the most complex skill, behavior is dependent upon kinesthesis. So long as an individual is alive and active, the kinesthetic receptors are constantly reporting on what is occurring in the musculature of the body.

One of the main roles of kinesthetic receptors is to report on movements that have been started or guided by another receptor system, such as vision, hearing, or touch. The kinesthetic perceptions of such movements are fused with other types of perceptions to produce a final integrated effect.

We have described the role of kinesthetic feedback in perceptually controlled movements in Chapter 4 (Fig. 4.27). One of the best examples of such feedback is in the regulation of lifting. When we lift an object, we first judge its weight by its size and appearance. If it turns out to be heavier than we estimated visually, the kinesthetic receptors give a sensory signal of this heavier weight and our muscles automatically adjust to it. The kinesthetic feedback

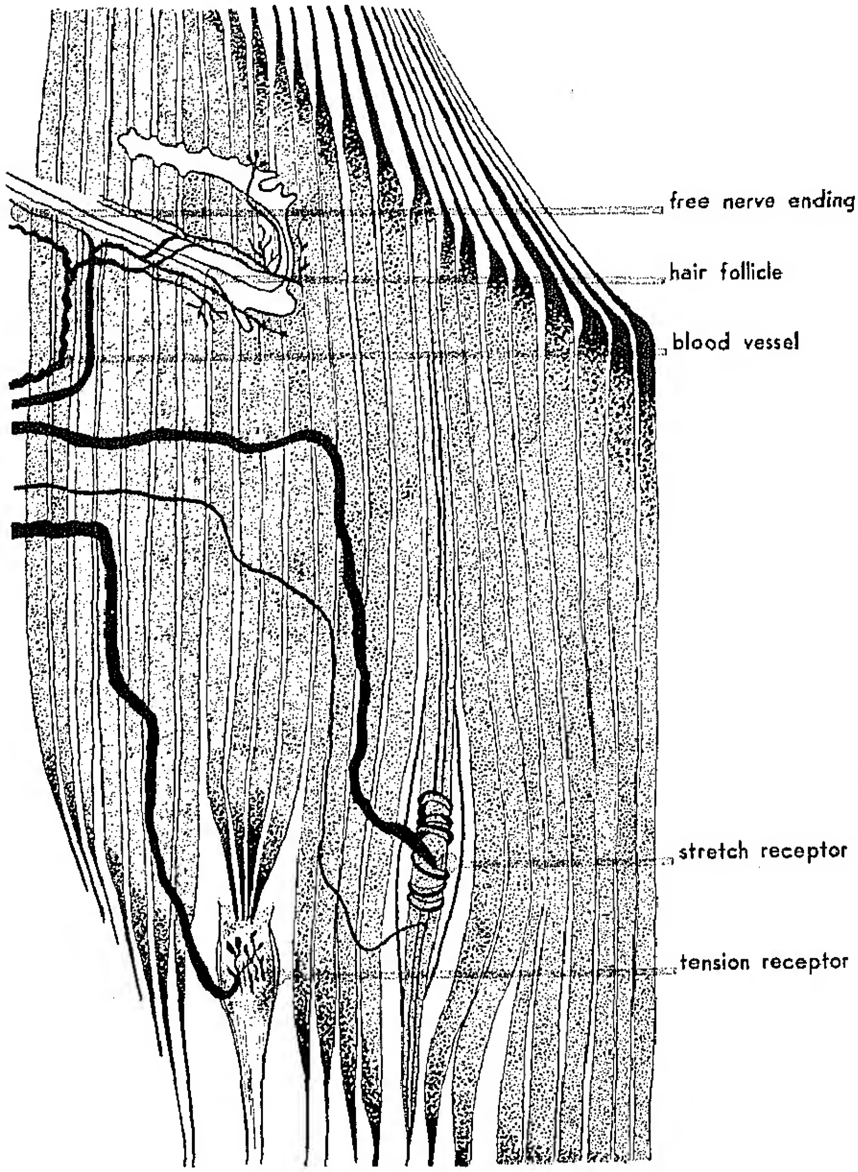


Figure 8.13. Simplified drawings of several types of kinesthetic receptors. When a muscle is under tension, the Golgi tendon organs are stimulated. Stretching (and perhaps contraction) is signaled by the receptors wrapped around muscle fibers. (Based on drawing in Creed, R. S., et al. *Reflex activity of the spinal cord.* Oxford: Clarendon Press, 1932.)

Figure 8.14. Apparatus to study perception of body position as influenced by vestibular and visual cues. The chair can be tilted independently of the rotation of the "room." (Photograph courtesy Dr. H. A. Witkin. Described in Witkin, H. A. Perception of body position and of the position of the visual field. *Psychol. Monogr.*, 1949, 63, No. 302.)

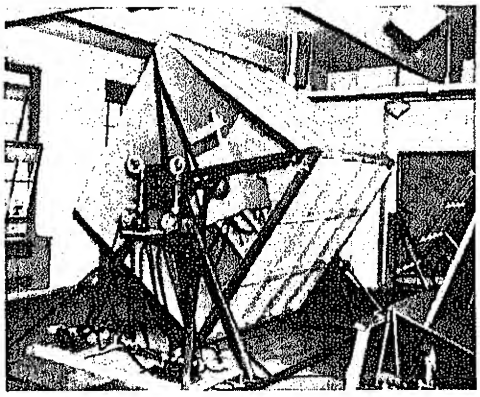
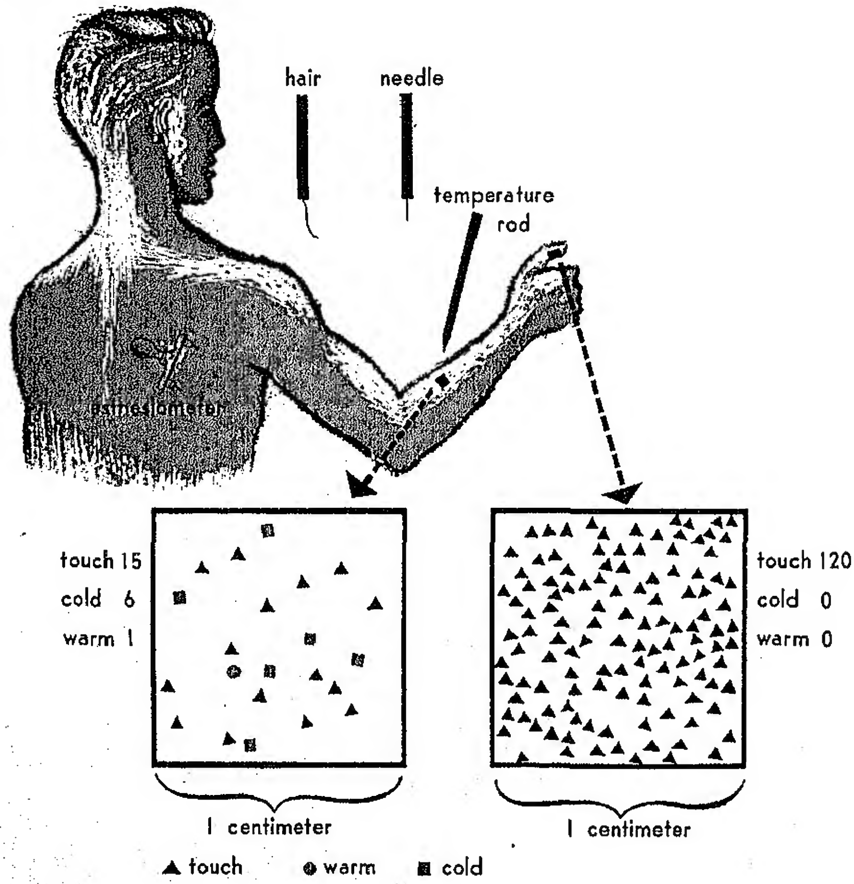


Figure 8.15. Study of cutaneous sensitivity. Appropriate stimuli are used to locate spots sensitive to touch, cold, warmth, and pain. An esthesiometer is used to test the two-point threshold. The sample maps do not show pain spots.



has corrected the movement to fit the force exerted by the weight.

Our bodily posture and our perceptions of position in space are regulated by the coordinated activity of kinesthetic, vestibular, and visual receptors. The elaborate apparatus shown in Figure 8.14 was devised to measure perceptions of bodily position relative to the up and down dimension in space. The room (the boxlike structure) seen in the picture can be rotated to any position away from a normal upright position. A subject sitting in the chair can be tilted independently of the movement of the room. Thus it is possible to vary separately the visual and vestibular-kinesthetic information concerning bodily position. Experimentation with the tilting chair and room has shown that some people are more dependent upon visual factors than are others. It appears that women depend more upon visual factors in their perceptions of the vertical position than do men.

Cutaneous Receptors. The skin contains an elaborate system of receptors which supply information on a variety of conditions in the world about us. Our comfort and sometimes our very lives depend on perceptions of pressure, heat, cold, or pain—traditionally known as the four qualities of touch. There are certain other perceptions, such as tickle and itch, which seem to be in a class by themselves.

The skin is not uniformly sensitive to stimulation. If an area of the skin is explored carefully with a sharp needle, it will be found that only certain spots respond with perceptions of pain. Other spots are sensitive to touch or heat or cold if stimulated with appropriate stimuli. The technique of plotting cutaneous sensitivity

and some typical distributions are shown in Figure 8.15. The stimulators used must be pointed so that a very limited area of skin is stimulated. Hot and cold pointed rods, stiff hairs, and sharp needles can be used to stimulate areas of the skin in a systematic way. The subject in Figure 8.15 has been tested in two small areas, each one centimeter square, on the thumb and forearm. In the thumb area, 120 spots were found to be sensitive to touch, but none to hot or cold points. The area on the forearm contains 15 touch spots, 6 cold spots, and 1 warm spot.

Skin sensitivity, besides being punctiform (point-to-point), also varies from one region of the body to another. One way of testing this sensitivity is in terms of the two-point threshold, using an esthesiometer such as the one shown on the back of the subject in Figure 8.15. To test the two-point *limen*, or threshold, the separation of the two points is decreased until they are perceived as one point. The two-point limen is less than 1 millimeter on the lips and finger tips but may exceed 10 centimeters on the skin of the back.

Another indication of varied sensitivity of the skin is the number of pain spots in different regions. There are about 200 pain spots per square centimeter on the forehead, breast, and lower arm, and about 50 on the nose and thumb. There are limited areas in the middle of the cheek and on the elbow which are almost completely insensitive to pain. In general, pain spots decrease in number from the torso of the body out to the tips of the fingers and toes.

Four kinds of cutaneous receptors are shown in Figure 8.16 as seen in a microscopic cross section of a piece of skin. Other skin receptors are hair follicles and free nerve endings. The distribution of these receptors accounts for the punctiform nature of skin sensitivity. We still do not know conclusively whether specific types of skin receptors are sensitive to specific tactual stimuli. Most psychologists agree that pain is aroused by stimulation of free nerve endings, which are widely distributed throughout the skin tissue. Perceptions of pressure may be aroused by stimulation of hair follicles and Pacinian and Meissner corpuscles.

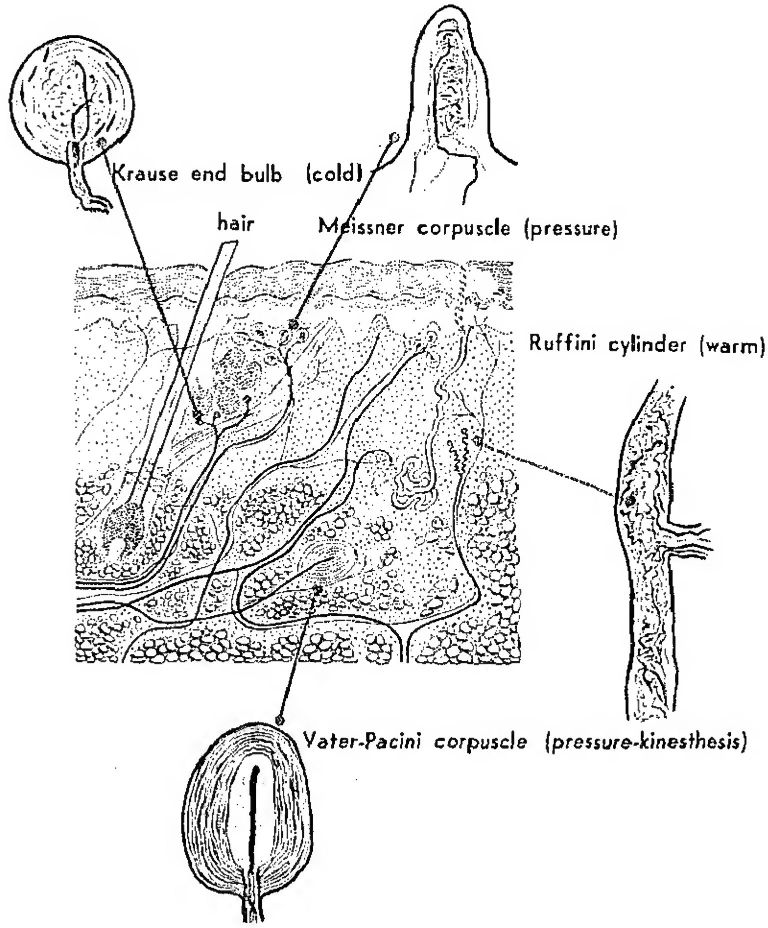


Figure 8.16. Specialized receptors in the skin. Stimulation of the receptors shown probably leads to the perceptions indicated, although the evidence is not completely satisfactory. Perception of pain undoubtedly arises from stimulation of free nerve endings. There are no known receptors for perceptions of tickle and itch. (Modified from Gardner, E. *Fundamentals of neurology.* Philadelphia: Saunders, 1947, and the *Stanford Medical Bulletin.*)

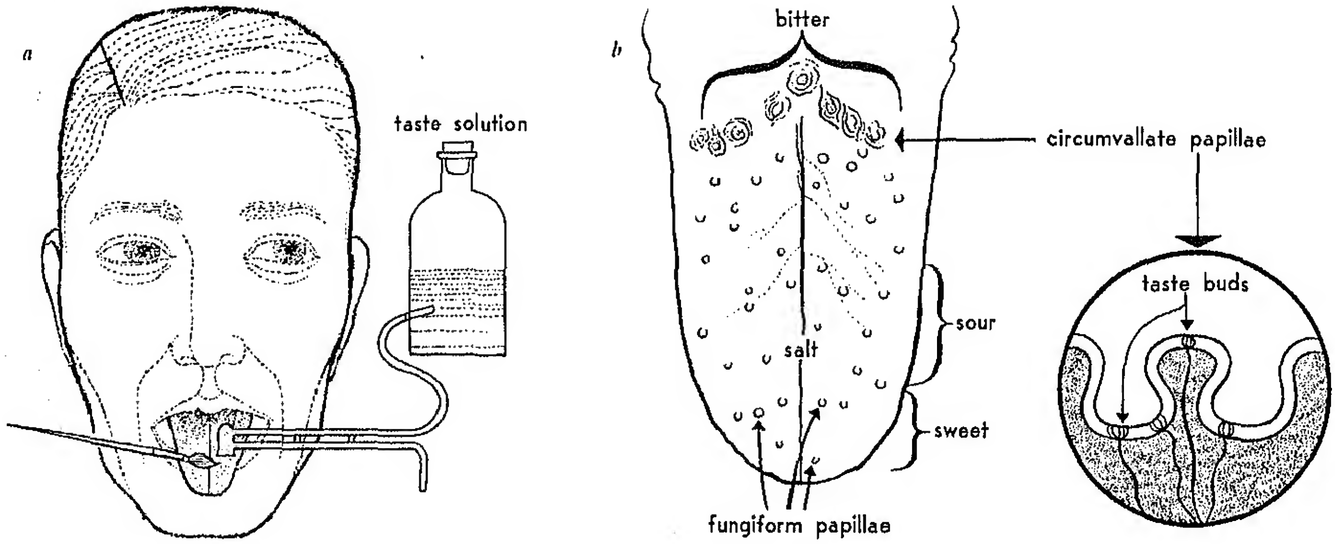


Figure 8.17. Study of taste. Differential taste perceptions can be studied by applying taste solutions to the tongue with a brush or taste cup. Perceptions of bitter, sour, and sweet are localized to some extent, but salt sensitivity is spread rather generally over the entire tongue. The inset shows how the specialized receptors, the taste buds, are located on and around papillae.

Receptors of Taste and Smell. Our taste perceptions are of four types: sweet, sour, salty, and bitter. These four tastes are produced by different chemical stimuli on the tongue and certain other parts of the mouth and throat. Along with the receptors for smell and certain other receptors located in and around mucous membranes, the receptors for taste are called chemical receptors or *chemoreceptors*.

As shown in Figure 8.17*a*, the effects of chemical stimuli are determined by placing controlled amounts of chemical substances on different parts of the tongue. One method is to touch the tongue at various points with a brush dipped in the chemical solution. A more elaborate and better controlled method is to use the taste cup, a little cup which is attached to a bottle containing taste solution and to a drain tube. When the surface of the tongue is stimulated locally by various taste solutions it is found that the four taste qualities are differentially localized. As shown in Figure 8.17*b*, sweet substances are generally perceived at the tip, sour substances along the sides and back away from the tip, salt rather generally over the entire surface, and bitter at the back of the tongue.

The actual receptors of taste are *taste buds*, budlike structures imbedded in *papillae* on the tongue. The inset in Figure 8.17*b* shows how the buds are arranged in one of the large circumvallate papillae at the back of the tongue.

Since taste receptors play an important role in the behavior of many animals, research on taste sensitivity contributes much to agricultural science and conservation. The lower thresholds for detecting chemical solutions are much the same in bees as in human subjects. Some fish, such as the catfish, taste substances with the whole body, since taste buds are distributed over most of the surface of the fish.

As shown in the diagram in Figure 8.18*a*, olfactory receptors are located in a small area high in the nasal cavity behind

the bridge of the nose. From the olfactory bulb of the brain hairlike filaments, or *cilia,* project downward into a small mass of mucous tissue called the olfactory area. These cilia are the olfactory receptors, and are stimulated by air-borne chemical particles. The sides of each nasal cavity have shelflike structures, *turbinates,* extending out into the cavity. In ordinary shallow breathing, air which is drawn into the nasal cavity passes around these turbinates and through the back of the cavity without coming into contact with the olfactory area. When we sniff, however, the air is drawn higher into the nasal chamber, comes into contact with the olfactory area, and some of the gaseous substances in it are absorbed by the receptors.

Controlled investigation of olfaction is difficult because odors themselves are hard to handle in a controlled way. They cannot be presented and withdrawn as easily as many stimuli, for once they are introduced into a situation they tend to remain. The enclosed booth shown in Figure 8.18*b* is an olfactorium, designed for the study of olfaction. The subject is sniffing an odorant and rating the intensity of various specific qualities such as spicy, oily, burned, and so on.

Olfactory perception itself is a most complex business. Psychologists have never agreed upon a classification of the many odors that we discriminate. Henning's classification, shown in Figure 8.18*c,* attempts to reduce all complex odors to various combinations of six basic or primary odors: fragrant, putrid, ethereal, resinous, burned, and spicy. These six are arranged on a hollow prism, and complex odors can be located at any point within it.

One way in which complex odors can be analyzed into their primary components

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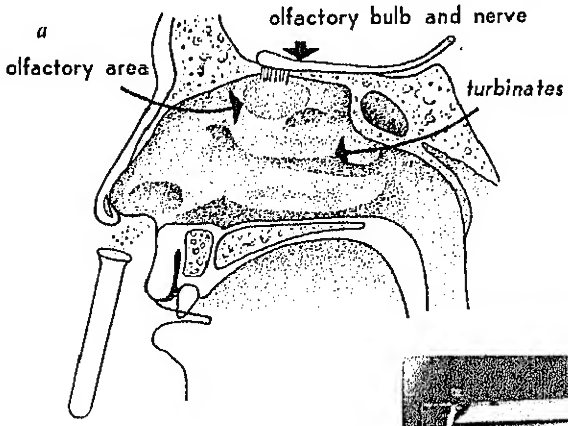
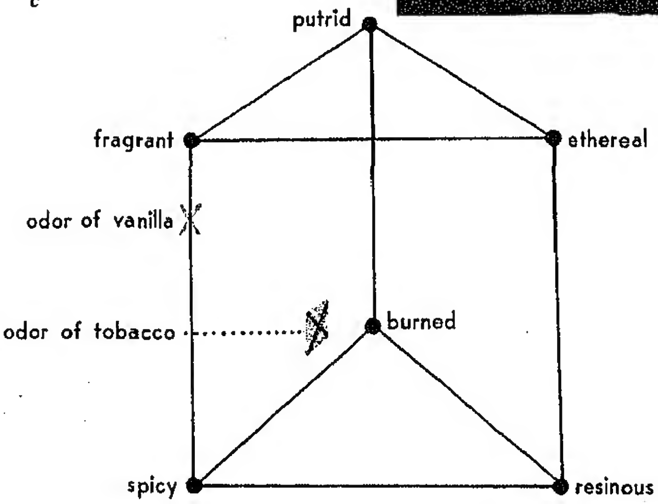


b

Figure 8.18. Study of olfaction. a. *Structure of olfactory apparatus.* b. *An olfactorium.* (Courtesy Food Acceptance Branch, Quartermaster Food and Container Institute, Chicago.) c. *One system of classifying odors is on a prism.* (From Henning, H. Die Qualitätenreihe des Geschmachs. *Z. Psychol.,* 1916, 74, 203-219.)

c



is by *selective adaptation.* If we smell a complex odor for some time, our perception of it changes as a result of selective adaptation of the olfactory receptors to the different primary odors within the complex. As we adapt to one primary odor, the total complex smells different. It is thus possible to identify the primary odors which make up such complex smells as vanilla and tobacco, as shown in Figure 8.18*c*.

What we ordinarily refer to as the taste of food is a complex perception of flavor, which is often more a matter of smell than of taste. You can prove this for yourself by holding your nose while eating several samples of food or a bite of mild soap. The distinctive flavor of some foods depends also on perceptions of touch and kinethesis. The flavor of celery, for example, is less a matter of taste and smell than of feeling and chewing. The temperature of foods also adds something to flavor, as do perceptions from what we call the *common chemical receptors*—free nerve endings in the mucous linings of the mouth and nose which are sensitive to some chemical substances. The bite of onion and garlic and the sting of a carbonated beverage are due to common chemical sensitivity.

Unrecognized odors sometimes give us feelings of familiarity or antipathy toward people and places. Recurring memories of childhood events in certain places can often be traced to odors that lead to recall of these childhood associations.

Olfactory sensitivity is more important in the organization of behavior than many of us realize. Among lower animals, especially, olfaction plays a vital role in the control of many kinds of activities. For example, seasonal migrations of certain fish, such as salmon, are directed by olfactory cues present in the home waters.

Organic Receptors. Inside the human body, in and around the major organs and the blood vessels, is a rich receptor network which forms the basis of our perceptions of such organic states as hunger, thirst, nausea, suffocation, sexual urges, internal pain and pressure, and distention. Most of the organic receptors are undifferentiated nerve endings, although there are a few more specialized receptors similar to some of the cutaneous receptors.

Some of our organic perceptions have the familiar qualities of cutaneous perceptions—pressure, pain, heat, and cold. We know that when we drink a very hot or very cold liquid we can feel it "all the way down." Other organic perceptions, such as hunger, are complex response patterns which may combine kinesthetic perceptions with other types of sensory signals to inform us of a state of bodily need. Bodily needs affect behavior both in terms of perceptual discriminations and in terms of sensory effects which are not directly discriminated. For example, sensory discharges from receptors in blood vessels alter the rate of breathing and intake of oxygen in the blood through their direct effects on the brain.

Pain resulting from an internal organic condition is sometimes localized not in the organs themselves but on the surface of the body. This we call *referred pain.* It is not imaginary pain but is as "real" as any pain perception. The basis of our false localization of referred pain is due to the close association in nerve trunks of sensory nerve fibers from the internal organs and other sensory fibers from free nerve endings in the muscles and skin. The pain from *angina pectoris,* a major disease of the heart, is typically referred to the chest, neck, and down the left arm.

MEASUREMENT OF PERCEPTION

Perception represents the general psychological relation between the individual and his environment. Perceptions change if the environment is modified in any way or if any change occurs in the individual, as in development, learning, or motivation. In the rest of the chapter we shall examine some of the variables which influence perception.

The primary phenomena of perception —that is, the psychological qualities and dimensions of color, sound, taste, smell, temperature, touch, and pain—are related in exact ways to the physical dimensions of stimuli. For example, we have said that the particular psychological dimensions of pitch, loudness, and timbre of tones vary directly with the physical properties of frequency, intensity, and complexity of sound. The field known as *psychophysics* is concerned primarily with measuring the relationships between the psychological dimensions of perception and the physical properties of stimuli. It should be remembered, however, that there is no simple one-to-one relationship between perceptual qualities and physical variables. Our perception of pitch varies with the frequency of sound waves, but it also varies to some extent with intensity of sound. Similarly, hue varies with wavelength, but also with the intensity and purity of the light stimulus. Perceptual dimensions are not caused by specific properties of stimuli; rather they represent the ways in which the living system is organized to respond to variations in the environment.

In Chapter 4 we saw that different modalities of perception have definite physical limits. Our visual receptors respond to only a small band of the electromagnetic spectrum. We hear mechanical vibrations as sound only in the frequency range from about 16 cps to 20,000 cps. We also learned that our perceptions of physical stimuli are limited by the intensity or magnitude of these stimuli. There is a certain intensity for any given frequency of sound wave below which we cannot detect the sound. Furthermore, there is an upper limit of intensity for each frequency of sound wave above which the sound will be painful or destructive to the ear. These limiting thresholds for different modes of perception are called *absolute* or *terminal thresholds*. They can be determined for all qualities of perceptual response. In Chapter 9 we shall describe the thresholds for rod and cone vision, and in Chapter 13, the thresholds for perception of sound.

Accuracy of Perception. Since perception is the means by which we "keep in step" with our environment, it is important that it be reasonably accurate. Many special problems in scientific fields as well as in business and industry require that we know rather precisely how accurate our perceptions are under different conditions of observation. Sometimes the procedure is to ask an individual to describe what he sees, hears, smells, or tastes. However, this simple method is frequently too crude and unsatisfactory because words are so often ambiguous. For that reason, special procedures and methods have been devised for studying and measuring the accuracy with which we detect, discriminate, and relate to one another the countless features of our environment. We call these procedures the *psychophysical methods.*

One of the more common ways of determining the accuracy of perception is illus-

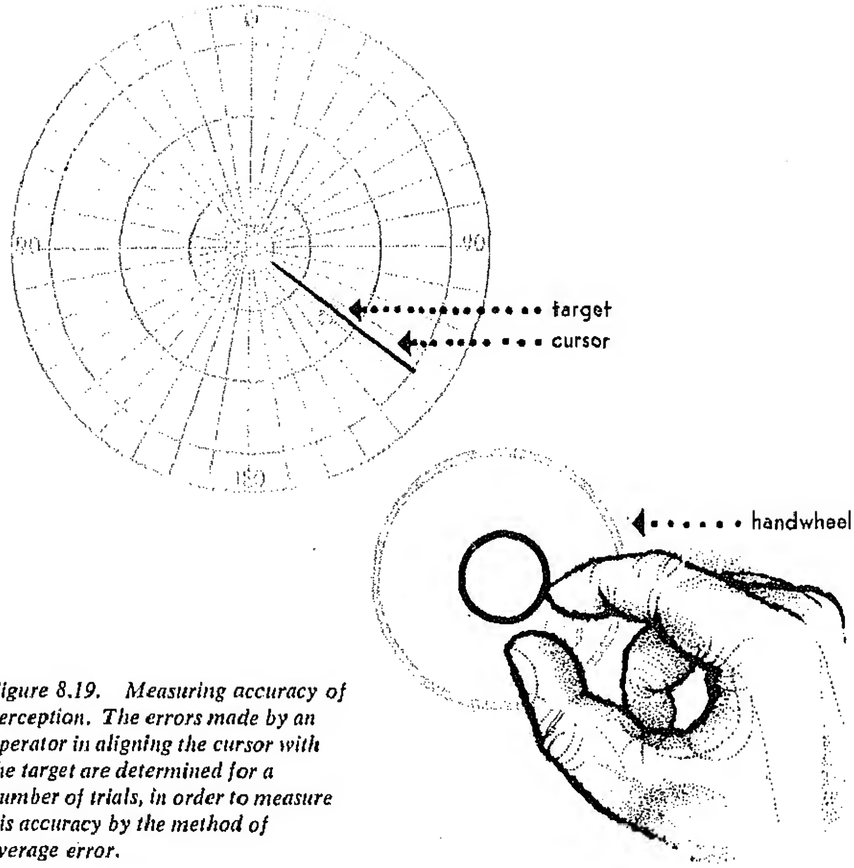


Figure 8.19. Measuring accuracy of perception. The errors made by an operator in aligning the cursor with the target are determined for a number of trials, in order to measure his accuracy by the method of average error.

trated in Figure 8.19. The task shown is that of reading a radarscope. The observer must adjust the movable line or cursor to the center of the "pip" or target on the face of the radarscope. In a real situation the pip might represent an airplane or ship, but in the experiment an artificial pip is put on the scope and its exact position is known. We measure how closely the operator aligns the cursor with the center of the pip in a number of trials, with the pip in a different position on each trial. We determine the error of adjustment on each trial and compute the average for all trials. This procedure quite naturally is called *the method of average error*. Any type of observation in which a variable stimulus (the cursor in the figure) can be matched to a standard or known stimulus value can be studied by this method. Illusory perceptions, which usually involve gross inaccuracies, are often studied with the method of average error.

Perception of Differences. Environmental differences in color, in sound, in form and size, in tastes and smells, or in any other stimulus dimension to which we are sensitive, characterize the world as we know it. The number of these differences we can perceive in a single psychological dimension is very large. For example, it is estimated from experiments that we can discriminate more than 1500 different pitches of sound. Considering the many different dimensions of perception and their combinations, the number of perceivable differences in the environment is beyond comprehension.

An important experimental approach to the study of differences in perception is the measurement of differential thresholds, or *just noticeable differences* (j.n.d.'s). In Figure 8.20 we see a standard stimulus weight (100 grams) and a series of variable weights ranging from 95 to 105 grams. The problem here is to find out how much difference there must be between two weights in order to perceive the difference. The observer first lifts the standard weight and then one of the weights in the variable series. He tells us if the second weight is heavier or lighter than the first. Throughout a series of trials the standard stimulus is given first for half of the time and the variable stimulus is given first for half of the time. By getting repeated judgments on each variable, we are able to calculate the percentage of

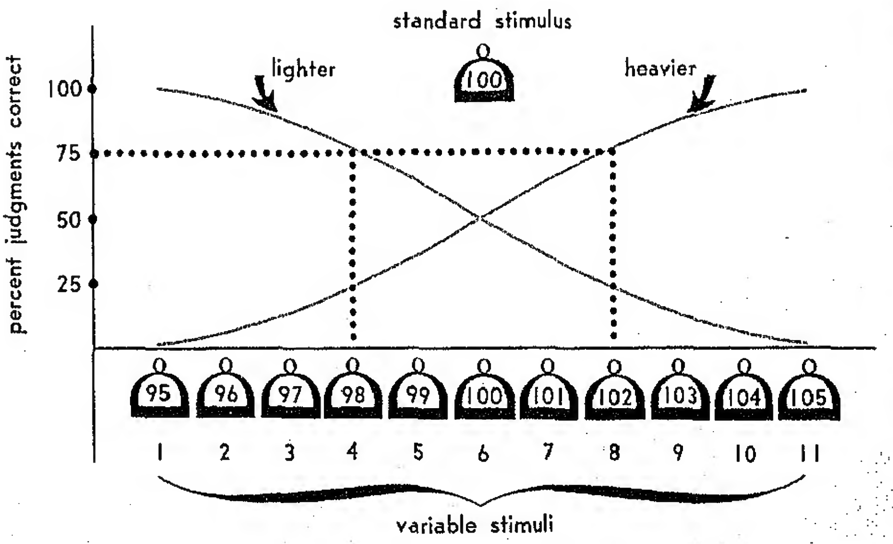
trials in which each variable weight is judged heavier and lighter than the standard. This procedure is called the *method of constant stimuli.*

In a situation like this, some variables will be judged with 100 percent accuracy if their difference from the standard is easily perceived. The variable which is equal in weight to the standard will be judged heavier as often as lighter by chance, if enough trials are given to assure an ideal chance distribution. Variable weights in between will be judged correctly between 50 percent and 100 percent of the time, depending on their difference from the standard. How are we to decide which weights (lighter and heavier than the standard) are "just noticeably different"? In other words, how do we determine the j.n.d.? The usual procedure in the method of constant stimuli is to take the point of 75 percent accuracy as defining the j.n.d. A difference which is perceived correctly 75 percent of the time is the difference threshold, or j.n.d.

The curves shown in Figure 8.20 represent the data that might be collected in a weight discrimination experiment with a very large number of trials. One curve represents judgments of "heavier" and the other curve, judgments of "lighter." You can see that 95 grams is judged "lighter" than the standard 100 percent of the time, and is judged "heavier" 0 percent of the time. On the other end of the scale, 105 grams is judged "heavier" 100 percent of the time, "lighter" 0 percent of the time. The curves cross at 100 grams, the weight which is judged "heavier" half of the time and "lighter" half of the time by chance. We get 75 percent accuracy at 98 grams and 102 grams. Thus the upper j.n.d. is 2 grams (102-100), and the lower j.n.d. is 2 grams (100-98). The average of the two measures—which is, of course, 2 in this example—gives the difference threshold. This is an idealized example. In actual experimental situations the data might show j.n.d.'s that are greater or even less than 2.

An important general fact regarding the perception of differences in different modalities is that a discriminable difference or j.n.d. is a relatively constant fraction of the value of the stimulus used as a standard. In our illustration the j.n.d. was 2 percent of the standard. The ratio of the size of the j.n.d. to the value of the standard stimulus is referred to as the *Weber ratio* or fraction, since a German physiologist, E. H. Weber, pointed out the relationship in the first systematic studies of psychophysics. The fact that this ratio is fairly constant under different conditions and for various modalities has led to calling the relation Weber's Law. It is now known that the ratio changes at the extremes of a range of stimuli. For very bright and very dim lights, for extremely large and very small sizes, for intense and weak sounds, and so on, the fraction is altered.

Figure 8.20. Measuring perception of differences by the method of constant stimuli. Each of the variable stimuli must be judged heavier or lighter than the standard stimulus in a number of trials. The curves are "psychometric functions" showing the percentage of each response at each stimulus value. The two points "just noticeably different" from the standard are arbitrarily set at the points of 75 percent accuracy.



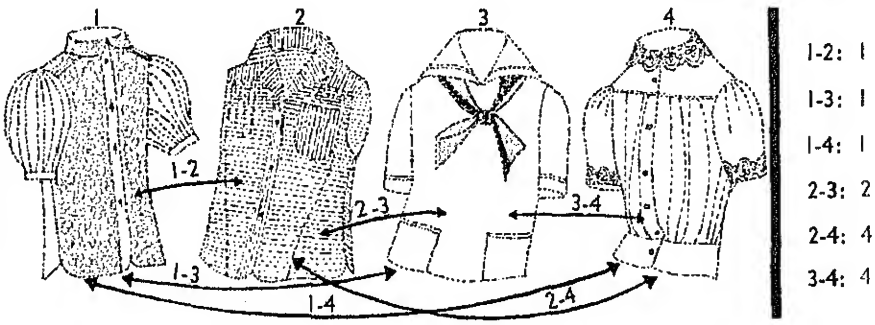


Figure 8.21. Perceptual scaling by the method of paired comparisons. Each item in the group is judged in relation to every other item, and the preferences recorded. As shown on the right, item No. 1 was preferred most often, item No. 4 next often, item No. 2 third often. Item No. 3 ranked last.

The smaller the value of the Weber fraction, the better the discrimination. Experiments have shown that the ratio is smaller for visual brightness, tactual pressure, and the pitch of sound than for other kinds of perception. For any kind of perceptual discrimination the fraction is usually smallest in the middle range of stimulus values.

Psychological Scaling. One important development in modern psychology has been an extension of psychophysical procedures to relatively complex problems of perception and judgment. These procedures have been adapted to measuring psychological aspects of perception in which the physical dimensions of stimuli are not obvious or easily isolated. In addition, psychological scaling procedures can be used to study how people order, prefer, and organize perceived differences and objects in relation to one another.

Psychological scales are not the same as physical scales. A 10-pound bag of sugar does not necessarily "feel" two times heavier than a 5-pound bag. Nor does a 50-watt light bulb appear twice as bright as a 25-watt bulb. In either case, doubling the amount on the physical scale does not necessarily double the psychological effect. To double the "feel" of 5 pounds, probably less than 10 pounds is needed. Some psychological scales are based on determinations of how much physical change is needed to produce a given amount of psychological change, such as doubling, or halving. Psychologists have constructed, for example, psychological scales of pitch, brightness, loudness, weight, and some other dimensions of perception.

The application of psychological scaling procedures to complex perceptual situations and objects such as musical selections, objects of art, attitudes and opinions, and commercial products has opened up an entire field of study of both practical and theoretical interest. In Figure 8.21 we see how scaling methods might be applied to the judgment of blouses for a clothing manufacturer. The scale of attractiveness for the blouses is established by having a number of judges make systematic comparisons among all possible combinations of pairs of blouses. The preferred blouse of a pair is indicated each time. An imaginary set of results from one individual is shown by the column of values to the right of the blouses. Blouse 1 was chosen three times, blouse 2 once, and blouse 4 twice. Blouse 3 was never preferred over any other. We call this the *method of paired comparisons*. With enough judgments from a large number of people, a scale of preference could be established which would be of value to the clothing manufacturer in his planning and production operations.

A scaling method which involves the assignment of ranks to the material to be judged is illustrated in Table 1. The different statements about a supervisor are ranked by a large number of judges on a scale of excellence from good to poor. The judges in making their rankings are not expressing how they feel about supervisors,

but are simply expressing their opinions of how the statements should be placed on a scale. Their combined rankings determine the rank value to be assigned to each statement. After the scale has been made up in this way, an employee can be asked to choose the statement which expresses his attitude toward his supervisor, and the chosen statement has a rank value in terms of the established psychological scale.

TABLE 1. *A Rank Order Scale*

Statements	*Established Rank*
My foreman is one of the best bosses I ever knew	1
My foreman is one of the worst bosses I ever knew	8
My foreman takes care of his duties	4
My foreman is sometimes lax in main responsibilities	6
My foreman knows his job but may not apply what he knows	5
My foreman gets along well in almost every aspect of his job	3
My foreman is outstanding in some of the work he does	2
My foreman may show extremely poor work in some of the things he does	7

Scaling procedures are an essential quantitative approach to all practical problems of perception, no matter whether they deal with color, sounds, odors, or the characteristics of general situations. If we are to understand how people respond perceptually to environmental events, we must measure, not the physical dimensions of stimuli, but the psychological variation in observed objects.

PERCEPTION IN TOTAL RESPONSE

We have seen how our perceptions depend on the nature of our receptor systems and their sensitivity to events of the environment. In some controlled situations there are very precise relationships between stimulus conditions and perceptual responses. Yet in our everyday behavior our perceptions are not independent events, but reflect the unity of organization of the individual. The perceived environment is a unified environment. The visual field of one eye is not seen as separate from the visual field of the other eye. In our observations of the physical events about us everything possesses order and relation.

Many perceptual observations reflect a high degree of integration among different types of perceptions. As we saw earlier, the flavor of foods combines taste, smell, and sometimes other qualities. Our perception of space, as we shall learn in the next chapter, is based on vision, hearing, touch, and kinesthetic processes.

This organization of the perceptual world is due to several different factors. The cerebral cortex itself is a remarkable integrative mechanism, enabling the individual to react to many distinct sensory impulses in an orderly and meaningful way. Then, too, the perceptual world is organized in terms of past experience and learning. The individual sees objects in his visual field instead of meaningless patterns of light and color partly because he has touched, handled, and moved around those same objects. But there are other more immediate factors that help determine what the individual shall perceive and how he shall perceive it—namely, the individual's emotional states, his needs and drives. Per-

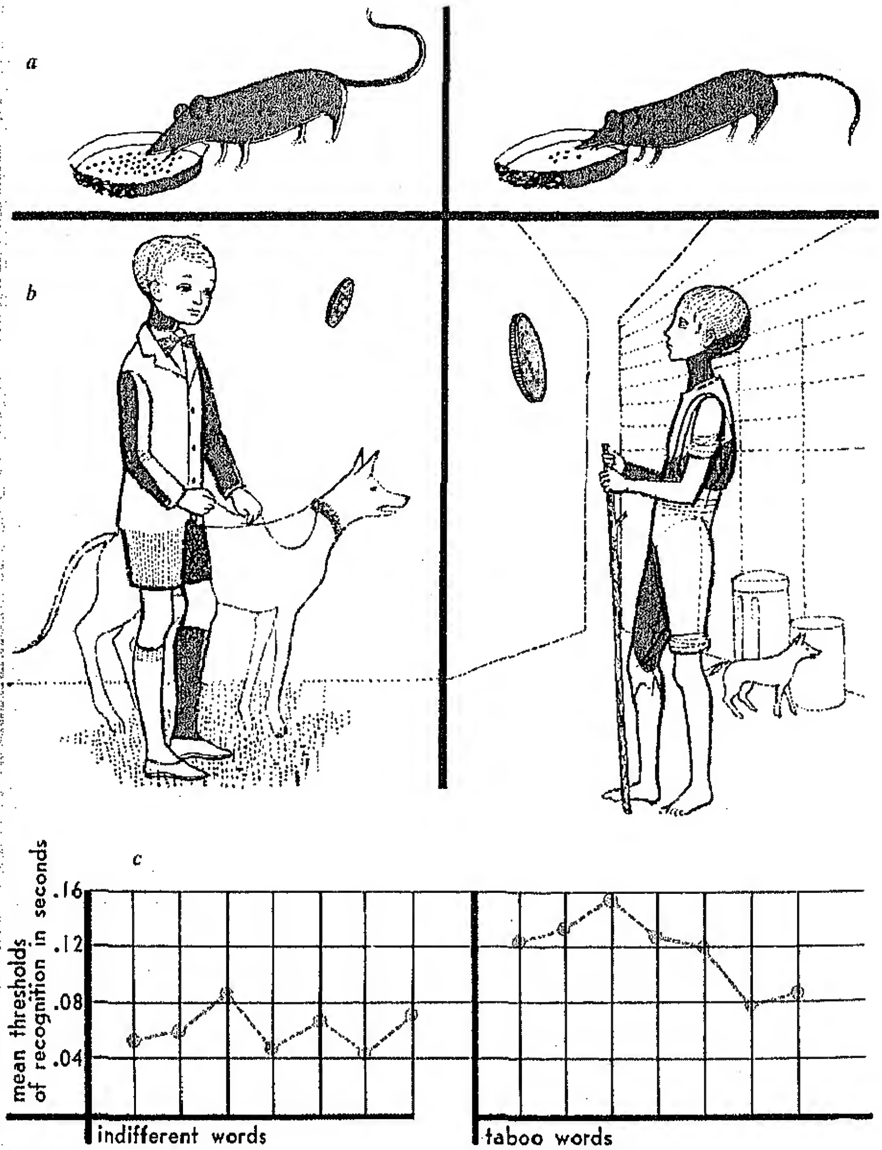


Figure 8.22. Effects of motivation on perceptual responses. a. *Salt-hungry rats showed lower thresholds for salt solutions than normal rats.* (Pfaffman, C., and Bare, J. K. Gustatory thresholds in normal and adrenalectomized rats. *J. comp. physiol. Psychol.*, 1950, **43**, 320–324.) b. *Money looked larger to poor boys than to rich.* (Bruner, J. S., and Goodman, C. C. Value and need as organizing factors in perception. *J. abnorm. soc. Psychol.*, 1947, **42**, 33-44.) c. *Perception time was longer for taboo words than for indifferent words.* (McGinnies, E. Emotionality and perceptual defense. *Psychol. Rev.*, 1949, **56**, 244-251.)

ception interacts with all other phases of behavior to determine total response.

Motives, Emotions, and Perception. An individual's motivational or emotional state determines to some extent the events toward which he directs attention. Thus if he is in love he notices different things than when he is hungry. It is also true that such motivational states may actually change the characteristics of perceived objects and events. Figure 8.22 summarizes a number of experiments which suggest *how detection and discrimination of critical* aspects of stimuli change with different motivating conditions.

The rat to the left in Figure 8.22*a* is a normal, healthy rat, shown drinking water containing a concentration of salt (indicated by the dots) that it can just detect. The second rat has had its adrenal glands removed and continually needs far more salt to stay alive than does the normal rat. It can detect a much lower concentration of salt in water than the first rat. The increased motivation of the salt-hungry rat lowers its threshold of detection of the substance. In other words, increased perceptual sensitivity of the organism has been brought about by a change in motivational state.

Motivational state also induces variations in discrimination of stimulus quality and magnitude, as shown in Figure 8.22*b*. The ragtail boy on the right sees money as being bigger in size than the lad of high economic status on the left. Similar experiments show that the perceived brightness of food objects varies with changes in hunger.[3]

Motivation also alters selective sensitivity to stimulus objects. Sensitivity to some stimuli increases and to others de-

creases with changed motivation. The time required to perceive words varies with the emotional connotation of the words, as shown in Figure 8.22*c*. Subjects who were asked to report words which were presented very briefly were able to recognize and report emotionally indifferent words after briefer exposure times than the times necessary for emotionally toned taboo words; that is, the time threshold for recognition of taboo words is higher than that for emotionally indifferent words. Perception of stimulus objects can be selectively altered by emotional state.

The interrelations between motivation, emotion, and perception are of central importance in the understanding of individual personality. The experimental variations in perception just described suggest the general dynamic role of perception in the adjustment and make-up of the individual. A more direct illustration of how perceptual organization is reflected in and plays a role in adjustment is seen in Figure 8.23. The girl is observing a stimulus card which contains an ink blot. She is asked to tell all that she sees in the blot and describes the witches dancing. The filling in, interpreting, and animating of relatively incomplete stimulus patterns in observation, such as perceiving the witches in the suggestive but meaningless ink blot, characterize the dynamic perceptual events of fantasy, artistic creative production and appreciation, and dreams. They also characterize our perceptions of the daily world in which we live. In the study of personality, the term *projection* is used to describe the organization of perceptual events in terms of dynamic factors of emotion and motivation.

The ink-blot perception emphasizes a fundamental aspect of the organization of the perceived world. Perceptions are defined not only by the stimulus patterns presented to the receptors, but also by the make-up of the adjusting system—its development, learning, thinking, and motivational state. The witches are the integrated outcome of the interplay of environmental stimulation, receptor processes, and dynamic factors of adjustment. The terms *behavioral field* or *perceptual field* are sometimes used to describe this organized perceived world about us in order to distinguish it from the pattern of physical stimulation as such.

The organization of the perceptual world not only reflects our emotions and needs, but the people and objects in it often have in themselves motivating value. In Chapter 6 we described the nature of

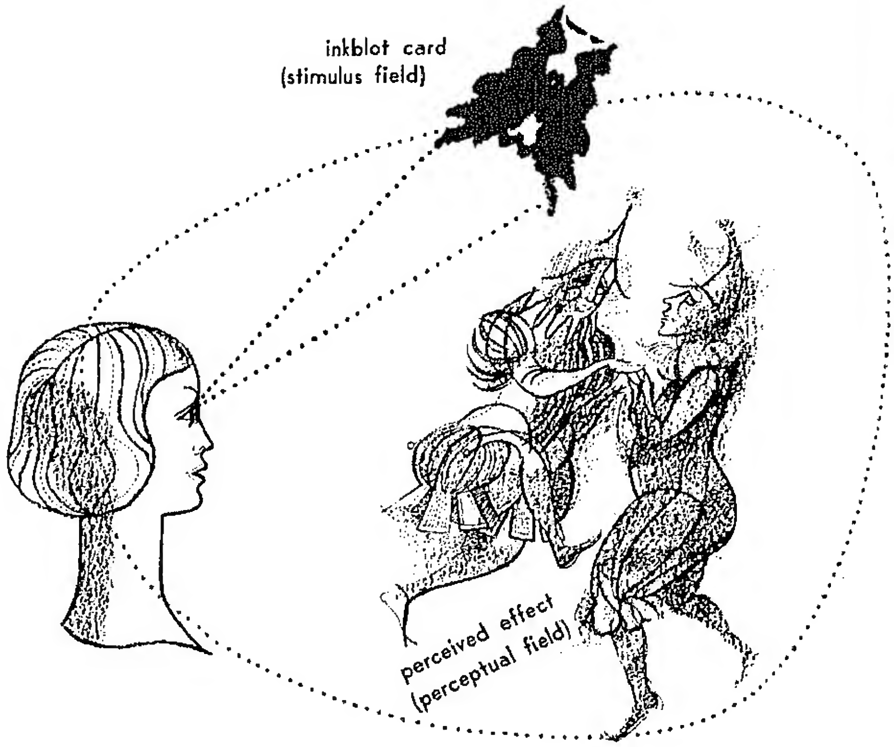
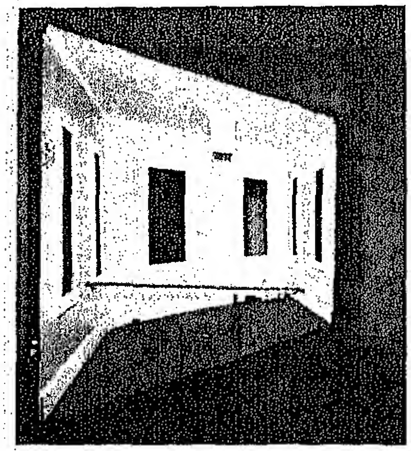


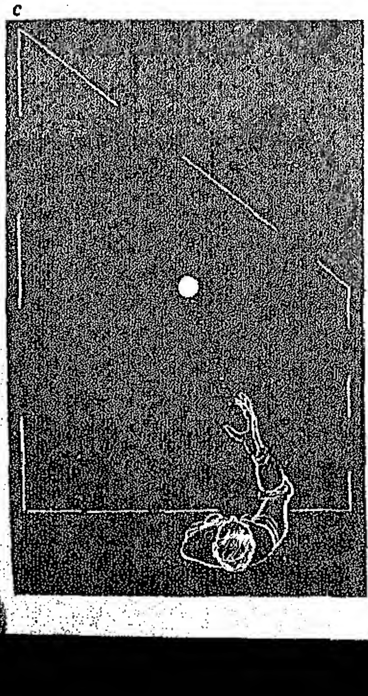
Figure 8.23. The dynamic interplay between perception and motivation. Our perceptions occur in the total and continuous stream of motivated behavior. What and how a person perceives reveal something about his total pattern of adjustive behavior or personality. Differences in motivation cause different people to perceive the same objective situation differently, and the same person at various times to perceive the same situation differently.



a

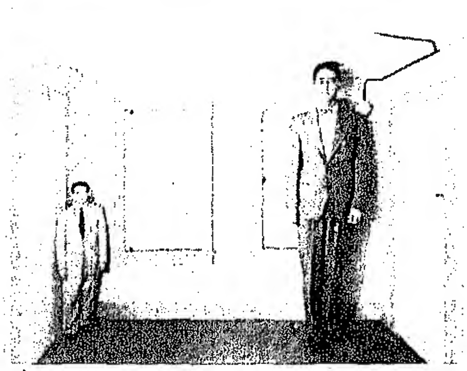
Figure 8.24. Change in illusory perceptions with learning. The distorted room, a, *is first perceived as normal under restricted conditions of observation,* b. *After perceptual-motor experience in the room,* c, *the illusions of normality gradually gave way to perception of the distortion.* (Kilpatrick, F. P. Two processes in perceptual learning. *J. exp. Psychol.*, 1954, 47, 362-370. Photographs courtesy Perception Demonstration Center, Princeton University.)

c



perceptual motivation—how perceptual objects and situations, both general and specific, influence learning and the course of behavior. The people around us, for example, are perceived in a larger matrix of needs, desires, or aversions. Specific persons in our perceptual field are not only perceived according to our motivational and emotional organization, but their presence motivates us to react in certain ways.

One requirement for satisfactory living is the opportunity to create, in some degree,



b

a perceptual environment which is pleasing. This is not just a matter of seeking those objects and people which are desirable and avoiding those that are not. More specifically, the individual is motivated to create, in a material sense, perceptual events which satisfy him. Painters, sculptors, and craftsmen work to create visual forms that satisfy themselves and others. Musical artists create a pleasing world of sound. Cooks, both professional and amateur, try to provide satisfactory perceptions of taste and smell. Much human enterprise is concerned with utilizing man's ability for fine perceptual discriminations to rearrange the events of his perceptual world.

Perception and Learning. The nature of perceptual organization is affected by past experience, learning, and thought. The ink blot shown in Figure 8.23 might mean many things to many people, but each observer's perception is organized in terms of his own behavioral history.

Learning and thought influence perception in many ways. Perceptual training is a necessary part of the learning of an art or skill—important in refining observation, speeding up the rate at which it is carried out, increasing the overall scope of observation, and reorganizing what is observed. In tasks and skills of all degrees of complexity—aircraft spotting, poker, surgery, driving, scientific observation, to mention just a few—perceptual training is a major aspect of the learning process.

We can see how important learning is in perception by studying the effects of early blindness on visual perception in individuals who have regained their sight through surgery on the cornea or lens.[4] Do these people perceive the environment normally? Initially they do not. Distance is not appreciated and the environment looks flat. Forms are indistinct and fine differences in color are not discriminated. Also, some of these patients give up trying to see and thus, in effect, remain blind. The full ability to see or to hear requires both practice and motivation.

The extent to which the organization of the visual field is affected by learning has been the subject of a number of experiments. One such study demonstrated how perceptions of distorted rooms are modified by experience with the rooms. Three rooms were used in this experiment. The first, shown in Figure 8.24*a*, was built with the back wall slanting backward toward the left. Thus the left wall was much larger

than the right. When people are observed in opposite corners of a larger version of this same distorted room, the room looks normal, but the people appear to be of different size (Fig. 8.24*b*). The second room used in this study had a ceiling larger than the floor, while the third room was an ordinary undistorted room. The subjects in this experiment were allowed to view the rooms through small openings in the front with one eye covered and were not told of the distortions. On first observation the rooms all looked normal to the subjects. They saw no differences among them.

After the preliminary observations the subjects, still with one eye covered, were given opportunities to "explore" the first distorted room. They used a long pointer to touch parts of the room and practiced throwing a ball at a target on the back wall of the room, as shown in Figure 8.24*c*. In this figure we are looking down on the subject and the ground plan of the first distorted room with its slanting back wall. After exploration and target practice in the room, its distortion became apparent to the subjects to some degree.

After their training in the first room the subjects were divided into two groups. One group was tested on the second distorted room, the one with the larger ceiling, and the other group on the normal room. In practically all cases, the subjects perceived the test rooms as distorted in the same manner as the room with which they had become familiar. The perceptual training in the first room transferred to the other rooms and produced perceptual reorganization based on learning rather than on the physical characteristics of the perceived objects.

There has been a long series of experiments concerned with inversions and reversals of the visual field by means of lenses, mirrors, and prisms. The general problem is whether a subject can learn to adjust to a radically changed set of perceptual signals from the visual field. In one of the first experiments on this problem, Stratton wore special lenses which inverted and reversed his visual field.[5] He wanted to know if he could learn to perceive everything normally or "upright" in this abnormal visual field. In Chapter 1 we saw photographs of more recent studies on this same problem at the University of Innsbruck.[6] In these studies a number of subjects were observed and for a much longer period of time than in Stratton's work. The Innsbruck studies confirmed Stratton's general observations that serious disturbances in orientation and performance occurred when the visual field was first changed. In time, however, readjustment to the inverted or reversed visual field took place in conjunction with relearning patterns of movements. In other words, a new system of visual-motor coordination was learned. There was no single point in time when the inverted visual field "flipped over" entirely to appear normal. However, after some weeks or months of training the subjects were able to perform effectively, and their visual field appeared stabilized. When the inverting lenses or prisms were taken off, the subjects again showed disturbances in visual-motor coordination.

A number of experiments in Innsbruck and in this country have been concerned with effects of distorting, reversing, and inverting the visual fields of chickens (see page 131f.) and monkeys.[7] We can conclude from this work that infrahuman animals show little or no ability to readjust to a radically changed visual field. The flexibility of visual perception in the human

individual and its susceptibility to change through learning apparently marks a fundamental difference in perception between man and lower animals.

An important new technique for studying perception and learning has been made available by the development of closed circuit television.[8] It is possible to substitute a televised view of one's own performance for direct vision of this performance. For example, a subject can write or draw by *watching his own televised movements.* Using this technique it is possible to displace, change the size of, and delay the visual perception of one's own activities. Such study may in time give us further insight into some of the intricate relations between perception and learning.

PERCEPTUAL ILLUSIONS

One of the most puzzling problems in the study of perception is to understand the nature of illusions. Our survey of the different physical, physiological, and psychological facts of perception gives us a background for dealing with this problem.

What is an illusion? Our first unconsidered answer might be that an illusion is a "false" perception. However, the nature of perceptual processes makes it just as impossible for a perception to be "false" as it is for a perception to be "true." Our perceptions give us information of the world about us, they represent the stimulating conditions to us, but they are never carbon copies of the environment. Ordinarily our perceptions give us fairly accurate information. When we discover by checking one type of perception against another that one type has been grossly inaccurate, we say that we have had an illusion. In other words, an illusion is a perception which is inconsistent with other perceptions of the same stimulating situation.

Illusions are more common in visual perceptions than in any other type (see Fig. 8.25), but no mode of perception is entirely free of them. Auditory perceptions of incorrect *localization* are *illusory;* e.g., the ventriloquist bases his whole act on a cleverly sustained auditory illusion. If we pick up a piece of dry ice, we may feel that we are being burned instead of perceiving extreme cold. Anyone who has had a tooth pulled will recall how large the "hole" felt when explored with the tongue. As a matter of fact, many food flavors can be described as illusory perceptions, inasmuch as we attribute the "taste" of the food to our taste perceptions and localize it within the mouth when it actually depends mainly on smell.

There is a well-known illusion of touch which you probably have experienced. Cross the first two fingers of your left hand, with the middle finger well behind the index finger. Now feel the tip of your nose with the crotch formed by the crossed fingers. Do you suddenly have two noses? Close your eyes and slide a pencil back and forth between the crossed fingers and you probably will feel two pencils. Now open your eyes and try it again. Does the illusion disappear?

This pencil illusion illustrates an important fact about illusory perceptions. Most marked illusions arise out of restricted conditions of perception. When more perceptual information is made available, the illusion may weaken or disappear. Thus when the touch illusion with the crossed fingers is monitored by vision, the illusion breaks down.

The illusion of the distorted room, shown in Figure 8.24*a,* which first appeared nor-

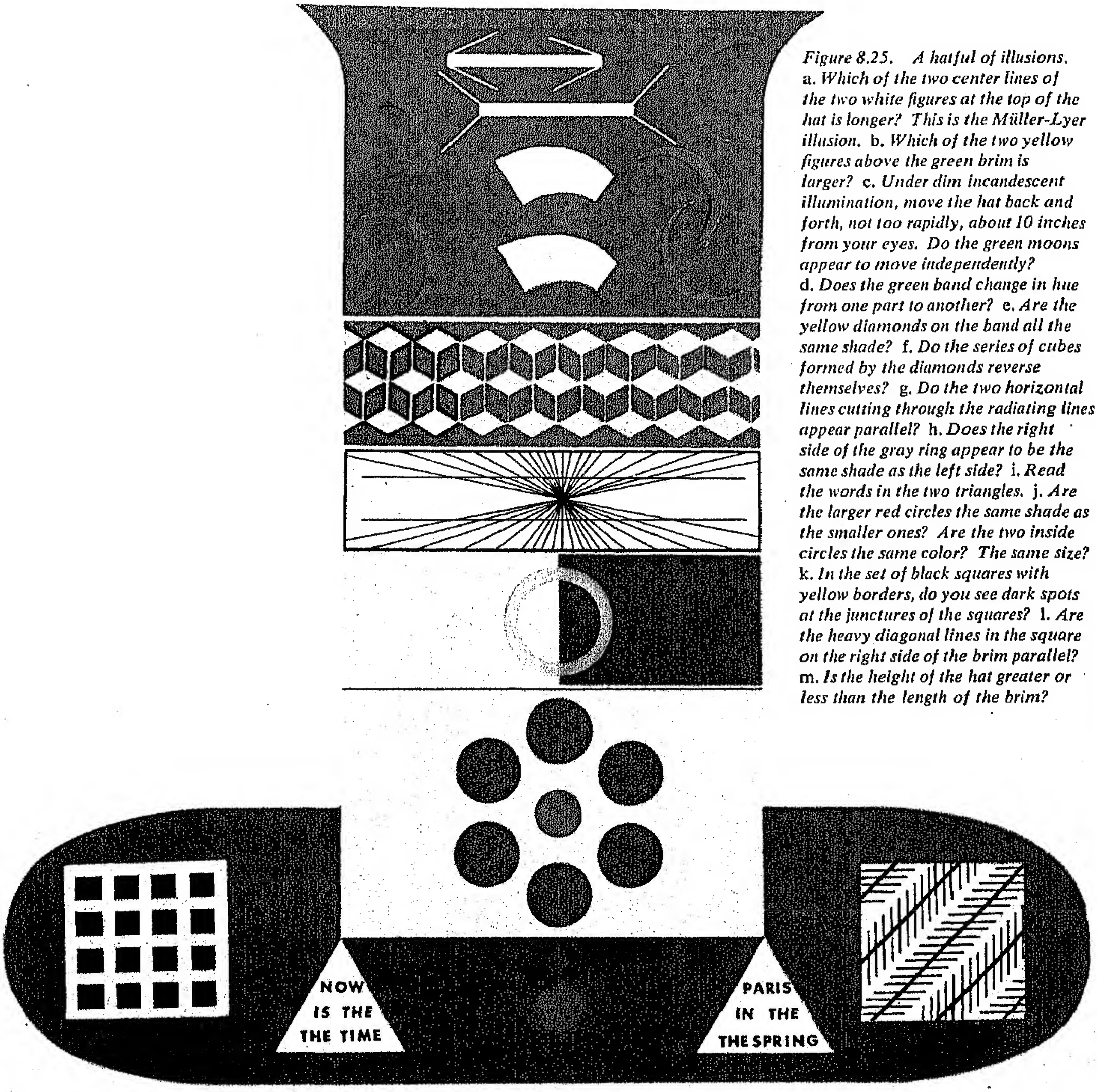


Figure 8.25. A hatful of illusions. a. *Which of the two center lines of the two white figures at the top of the hat is longer? This is the Müller-Lyer illusion.* b. *Which of the two yellow figures above the green brim is larger?* c. *Under dim incandescent illumination, move the hat back and forth, not too rapidly, about 10 inches from your eyes. Do the green moons appear to move independently?* d. *Does the green band change in hue from one part to another?* e. *Are the yellow diamonds on the band all the same shade?* f. *Do the series of cubes formed by the diamonds reverse themselves?* g. *Do the two horizontal lines cutting through the radiating lines appear parallel?* h. *Does the right side of the gray ring appear to be the same shade as the left side?* i. *Read the words in the two triangles.* j. *Are the larger red circles the same shade as the smaller ones? Are the two inside circles the same color? The same size?* k. *In the set of black squares with yellow borders, do you see dark spots at the junctures of the squares?* l. *Are the heavy diagonal lines in the square on the right side of the brim parallel?* m. *Is the height of the hat greater or less than the length of the brim?*

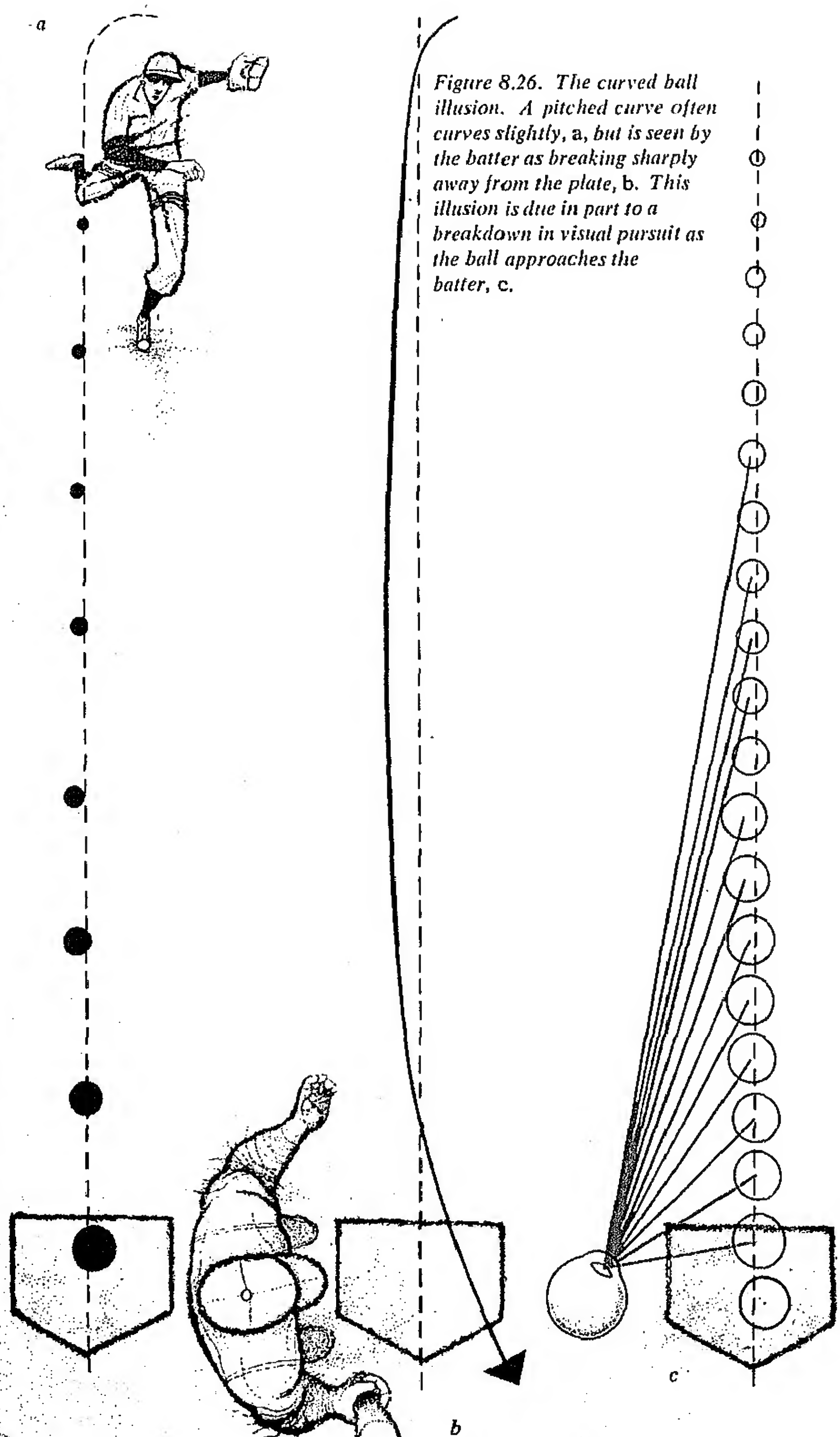


Figure 8.26. The curved ball illusion. A pitched curve often curves slightly, a, *but is seen by the batter as breaking sharply away from the plate,* b. *This illusion is due in part to a breakdown in visual pursuit as the ball approaches the batter,* c.

mal was undoubtedly due to restricted conditions of observation. You remember that the subjects viewed the room from a stationary position and with one eye covered. However, when they were permitted to collect more information about the room through touch and kinesthesis, the illusion disappeared.

Many special situations in life demand restricted conditions of observation which enhance illusory perceptions. The perception of the curve of a pitched ball, as seen by a batter, is an illusion which is probably defined very largely by the special conditions of the batter's observation. The amount of curve perceived is much greater than the physical curve in flight as measured by photographs. Figure 8.26*a* gives a diagram of the slight gradual variation of a pitched "curve" from a straight line. A batter watching the approach of a curved ball perceives a sudden "break" near the plate, as shown in Figure 8.26*b*. An explanation of the batter's perception of the curve is given by the diagram in Figure 8.26*c*. The apparent break arises from three main factors in the batter's perception of the situation: the slight curve in the ball's actual path, the angle of approach of the ball toward the side of the batter, and the failure and change of visual pursuit of the eyes as the ball nears and passes the batter. All these factors combined give the batter the impression that he sees the ball coming toward him and then breaking off sharply away from the plate.

Some illusions can be attributed to conflicting conditions of perception. Often the conflict arises between learned habits of perception and present conditions of stimulation. The auditory illusion of the ventriloquist is of this type. When we look at the dummy on his knee, our habits of localizing

speech are too much for us and we hear the words issuing from the dummy's mouth. The distorted rooms first were perceived as being squarely built, because people are accustomed to rooms with square corners. However, in this case the learning of new coordinations within one of the rooms enabled the subjects to overcome their illusory perception of this room, but resulted in a new "illusion" with respect to the other rooms. To some extent we see what we expect to see, or are accustomed to seeing.

Still other illusions seem to arise from particular properties of the perceptual mechanism, especially the receptors. A number of illusions of this sort are included with the hatful of illusions in Figure 8.25. For example, look at the circular arrangement of large red dots on a yellow background, and then at the small red dots on the blue background. Do the two "reds" appear identical? Actually they are identical. The perceived difference in hue between the large dots and the small dots is an illusory contrast effect.

Visual illusions are of many types. A great number of geometric and color illusions and reading errors are shown in Figure 8.25. Many of these illusions have been studied experimentally. Some can be changed by learning, others by attitude and motivation. As we have said, some hinge on factors of interaction between stimulus patterns in the visual field as related to receptor and neural factors in color and space perception. The caption explains how all of these illusions can be observed.

The study of illusions cannot be dismissed as an interesting sideline in psychology. We shall see in the next chapter how difficult—even impossible—it is to draw a line between perceptions of our world which are illusory and those which are not.

SUMMARY

Perception is differential response to environmental stimuli. Perceptions are not exact copies of the world, but are organized according to the nature of the behaving organism. Perceptual responses may involve detection, discrimination, or ordering of stimuli.

The visual receptors are the rods and cones, located at the back of the eye in the retina. The rods are sensitive to differences in light intensity at low levels of illumination, while the cones give us our perceptions of different colors at higher levels of illumination. Both rods and cones regain their maximal sensitivity when they are not being stimulated, and become less sensitive when they are stimulated. This process of adaptation is also seen in other receptors.

Our perceptions of sound vary in pitch, loudness, and timbre, attributes which are correlated with frequency, intensity, and complexity of sound waves. The receptors of hearing are hair cells located on the basilar membrane of the cochlea. Pitch discrimination depends in part on the ability of the auditory nerve to reproduce the frequencies of sound waves, and in part on the differential response of different areas of the basilar membrane to sounds of varying frequencies.

The vestibular labyrinth of the inner ear gives us perceptions of position of the body in space and of the pull of gravity. Kinesthetic receptors in the muscles, tendons, and joints give information about bodily movements and are essential in regulating all kinds of organized movements.

The skin has a punctiform sensitivity

to heat, cold, pressure, and pain. Great *variation in sensitivity exists from one region of the body to another,* as tested by the two-point pressure limen or by the number of pain spots.

Taste perceptions from taste buds in the *mouth are sweet, sour, salty, or bitter.* The "taste" of food—rather, its flavor—also involves smell, touch, and kinesthesis. Olfactory perceptions from the olfactory area in the nose have been classified in a number of ways. *One classification of primary* odors lists fragrant, putrid, ethereal, resinous, burned, and spicy odors.

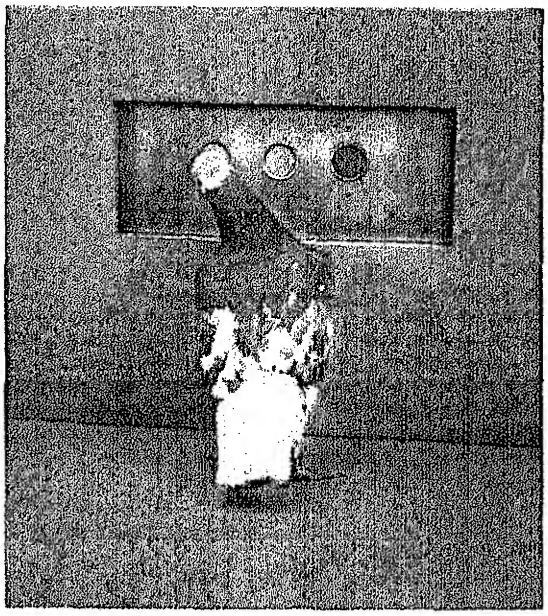
Sensory information about the internal organs of the body produces some percep*tual discriminations and also affects* behavior directly without being perceived.

The field of psychophysics measures relationships between physical properties of stimuli and perceptual response. Only cer*tain kinds of energy are perceived and in* only certain amounts, defined by stimulation thresholds. Accuracy of perception can be measured by the method of average error, differential perceptions by the method of constant stimuli, and different stimuli *can be arranged on a scale by the method* of paired comparisons. The fact that a just noticeable difference between stimuli is a relatively constant fraction of the standard stimulus is known as Weber's Law.

Motives and emotions help determine what stimuli will be observed and also help determine their characteristics. The individual organizes his own perceptual world in terms of his personal goals, needs, and desires.

Many perceptions depend on learning. Our observations of form and space in the visual world depend on visual experience as well as on auditory, tactual, and kines*thetic experience.*

An illusion is a perception which is inconsistent with other perceptions of the same stimulating situation. Illusions are often due to restricted conditions of ob*servation. Some of them are enhanced by* learned habits of observation; others depend mainly on the mode of action of the response mechanism, especially the receptor system.



CHAPTER 9. PERCEPTION: OBSERVING THE WORLD

The complex perceptual world in which we live is patterned according to the dynamic organizing processes of behavior. For example, the field of vision is made up of a countless array of patterns perceived as persons and objects—books, houses, automobiles, trees, and animals. Furthermore, these perceptual patterns are perceived by the individual as being pleasant, artistic, amusing, unpleasant, or even nauseating. As we have seen in Chapter 8, perception is more than passive detection and discrimination. It involves attention, expectancy, emotion, drives, and other phases of reaction which establish the mood and atmosphere of the perceived environment.

The dynamic aspects of perception show up most clearly in attention—the directed activities of observation. We are going to describe some of the events of attention and the factors which are important in attracting and directing it. Thereafter we shall attempt to analyze how our detailed perceptual observations occur—particularly those of form, space, and color—and how they vary with different stimulus conditions.

ATTENTION

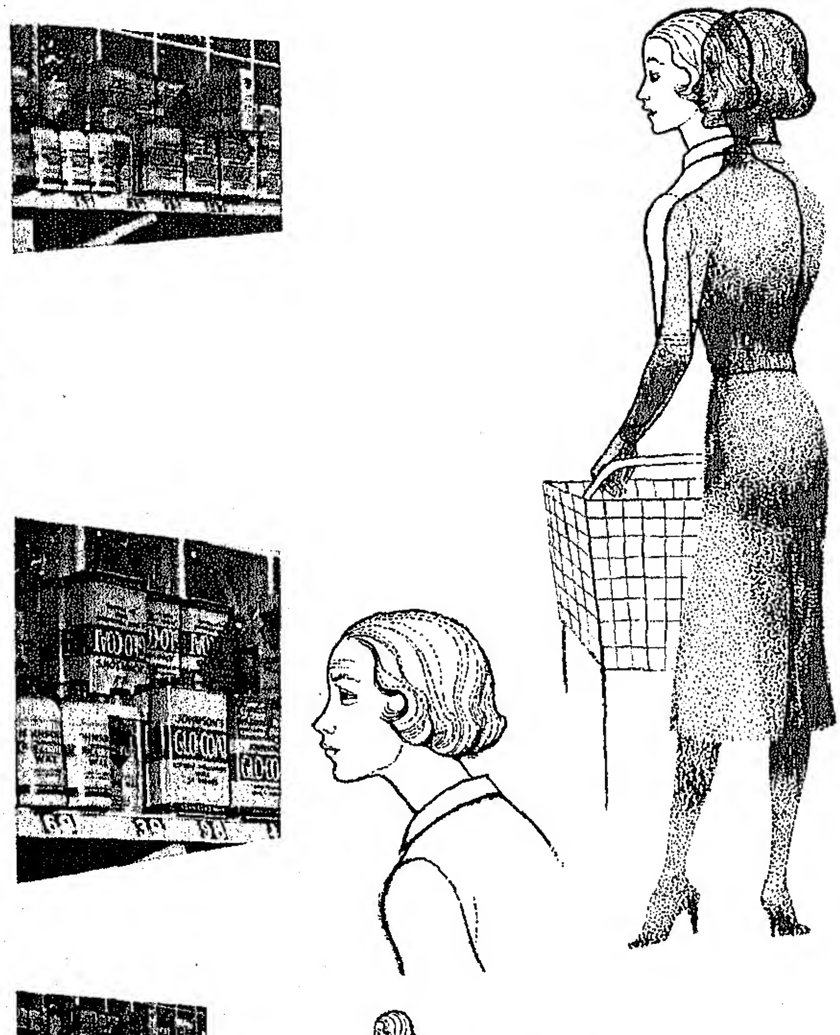
Attention is the active, selective aspect of perception, involving the preparation and orientation of the individual to perceive a particular stimulus pattern. The innumerable details that make up the envi-

ronment are not uniformly effective in perception at any given time. Not all the sounds around us or the pressures of our clothes on our bodies are detected at a given moment. In periods of high emotional excitement we may become oblivious to everything except the object of emotion. Attentional action is involved in the selection of special features of the stimulus world.

The different stages involved in most observation are shown in Figure 9.1. In the *preparatory action,* the woman going along the aisle of a supermarket notices strange detail in the scene in front of her. Some of the cans are upside down. Her pause, to look more closely, is a preparatory act of perception. This stage, varying from the pause to a startled fixation brought about by a danger signal, involves special bodily reactions. The pupils of the eyes constrict, the brows knit, and tension increases throughout the body. The preparatory stage of perception, often exaggerated, is familiar in vaudeville comedy. The "double take" of being startled by something strange or unusual appears to be a timeless form of humor.

The *second stage of perception is one of orientation,* at which time the individual directs and increases his efforts in observation. The head and body are oriented toward the perceptual objects and the hands and fingers may make preparatory grasping movements. In sustained orientation the nostrils may be dilated. In Figure 9.1, the woman moves up to the display in order to bring it into full view.

Perceptual preparation and orientation together represent the behavior of attention. They make possible detailed and accurate observation by restricting the perceptual field to some critical part or area.



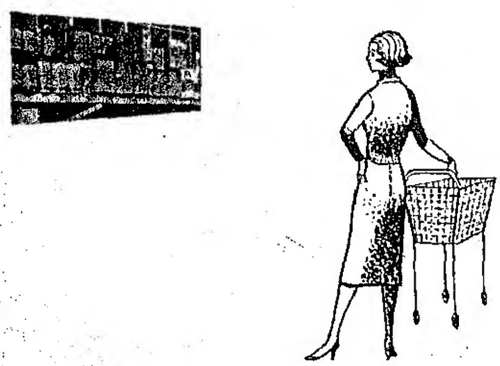


Figure 9.1. Stages of observation. The first two stages indicated, those of preparatory action and orientation, are commonly referred to as "attention." The third stage of observation is that of sustained perception. Factors within the individual, relating to motivation and emotion, become more important than stimulus factors in directing sustained perception.

Moreover, preparation and orientation in relation to simulus patterns are the starting phases of skilled motions.

The third stage of perceptual activity was described in detail in the last chapter, where we called it simply perception. Now the individual concentrates on the stimulus patterns in the restricted field of observation. The woman in Figure 9.1 may change her orientation to get a special view of the situation, much as the artist does in appraising what he has done. In some situations this sustained phase of perceptual judgment and action may go on for hours, but in the case of our shopper it is soon over. She decides to buy one of the inverted cans and goes on her way to be attracted by some other incidental event farther down the aisle.

Stimulus Factors in Attention. What are the factors that guide our "choice" of perceptual objects? What determines which stimuli we shall pay attention to and perceive and which ones we shall ignore? The determining factors in attention are of interest not only to the psychologist, but also to the merchant, the advertiser, the marketing expert—to anyone who wants to attract and hold the public eye. Advertising and selling depend not only on the momentary attention of a potential buyer, but on his sustained attention to the point where he wants to buy. The factors that attract attention momentarily are not always effective in holding it for any length of time.

The determining factors in momentary attraction can be considered in two general classes. First are the stimulus factors, those variables in the stimulating situation itself that cause the individual to attend. Second are factors within the individual that help determine his choice of perceptual objects. These have to do with motivation and emotion, as well as with habit and past experience.

The stimulus factors that command attention are the relative size, position, movement, contrast, intensity, form, color, duration, and repetition of parts of the stimulus field (Fig. 9.2). These conditions are well defined in the fields of marketing and advertising, where visual and auditory displays are carefully calculated to take advantage of them.

The size of advertisements, as well as the size of ordinary perceptual objects, helps determine their attention-getting value. We turn to look at an extra-large dog or an extra-tall man. A super-sized egg, or potato, or pumpkin may even be photographed for the daily paper. Intensity in any stimulus quality—the loud noise or the bright light—attracts attention.

In advertising it is known that the position of an ad on the printed page is important. The upper right position on a page has more attention-getting value than any other. Contrast, form, color, and repetition are useful variables in visual displays. Red and blue are usually more effective than other hues in attracting the eye. Colors are also used at times to induce mood effects. Repeated stimulus patterns and sharply defined forms attract attention more than hazy or blurred patterns. Visual displays which use movement, such as neon signs, are very effective.

The stimulus determinants of attention are significant in practical problems of safety and accident prevention. An illustration of experimental work in this field is an investigation of the effectiveness of mechanical turn signals on automobiles.[1] The American type of blinking signal was compared to arm-type flip signals found on

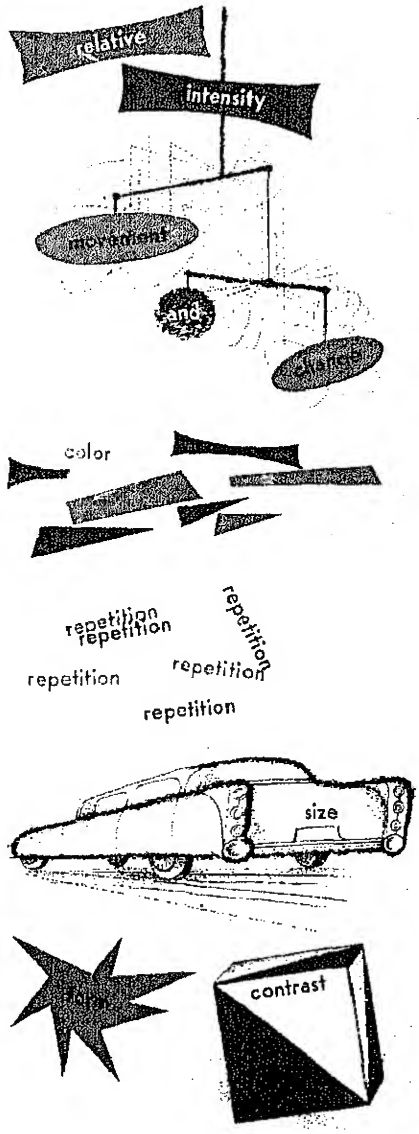


Figure 9.2. Stimulus factors in attention. Factors in the stimulating situation are important in attracting momentary attention. These attention-getting devices are used advantageously in marketing and advertising.

British automobiles. In general the lighted flip-signal was noticed and reacted to faster than the blinking, stationary light.

Individual Factors in Attention. In addition to the stimulus factors, the events to which an individual attends are determined by factors within himself. Often we perceive what we expect or are prepared to perceive, meanwhile ignoring many other stimulus objects. The woman who has mislaid a valued ring will look all over the house, prepared to react to the familiar pattern of the ring. While she is searching, her eyes fall on dozens of other objects, yet she pays attention to none of them. Sometimes our expectation, or *preparatory set,* prevents accurate perception: We do not actually perceive those stimuli for which we were not prepared. Thus in the hatful of illusions in Chapter 8, most people overlook one "the" in "Now is the the time."

Our preparatory set in perception is often determined by habitual modes of reacting. The shopper in a supermarket perceives the items on the shelves that she is accustomed to buy unless an unusual stimulus attracts her. In a neighborhood where there are many young children, a mother pays little attention to the cries of a child until she hears one of her own crying. This familiar voice attracts her and she goes to set things right.

As a rule, the objects and events to which we pay sustained attention are those that induce or symbolize a motivational or emotional state. We have already learned that some objects and events in the world about us have sustained motivating value. Some unpleasant stimuli, like bad odors, initiate behavior that is attentive in a negative way, in the sense that the individual reacts with aversion. Others induce approach behavior. In advertising the motivating value of a perceptual display is considered just as carefully as the stimulus factors.

In studies of the relative attention-getting value of different motivating factors, it has been found that different advertising themes vary in their attraction for men and women. Table 2 gives a comparison of ten such themes ranked according to their attention-getting value for the sexes.[2] Of the ten factors studied, those showing the greatest sex differences were vanity and health. Otherwise, men and women were fairly consistent in ranking the strengths of the different advertising themes.

TABLE 2. *The Value of Advertising Themes in Attracting Men and Women*

Theme	*Men's Rank*	*Women's Rank*
Quality	1	3
Sex	2	1
Fear	3	6
Emulation	4.5	4.5
Novelty	4.5	8
Vanity	6	2
Ambition	7	7
Economy	8	9.5
Efficiency	9	9.5
Health	10	4.5

There is much individual variation in the environmental events that people pay attention to as a result of special training and experience and the motivating effects of one's own interests. A bird-watcher sees birds and hears bird-calls that many people are never aware of, even though he may be thinking of something else. A scientific education includes a certain amount

of training in the activities of attention and perception. A scientist must know to some extent what he is looking for and the distinguishing marks that identify different events. On the other hand, many people habitually attend more to their own thoughts and plans than to the objects and events in their immediate environment. The "absent-minded college professor" is a person whose attention is guided and held more by individual motivating factors than by the stimulus factors in his physical environment. There is also an age difference in habits of attention. One of the changes between childhood and adult life is the increasing influence of individual psychological factors as contrasted to specific stimulus factors in guiding attention.

Distraction. Any stimulus situation which attracts attention can be considered a distraction if it interferes with behavior-in-progress. An investigation of distraction in the study activities of college students showed that the effects of distracting conditions on sustained attention to work depended to a great extent on what effects the subjects expected from the distraction.[3] The subjects in this experiment were required to add numbers mentally while music was used as a distracting stimulus. One group of subjects was told emphatically beforehand that the music would distract them. A second group was told that the music would be helpful, and a third group was told that it would make no difference. The results showed that those subjects who thought that they would be distracted by the music did not add as well as the other groups. Those who expected the music to have a helpful effect on performance worked better than either of the other two groups. Thus the variation in attention and performance under potentially distracting conditions depends, in part at least, on whether the individual expects to be distracted.

This is another way of saying that our preparatory set influences our activities of attention and perception. When we are strongly motivated to give our sustained attention to what we are doing, we are less likely to be attracted by extraneous stimuli. As we said above, the factors that attract attention momentarily are not always effective in holding it. As a rule, we give our sustained attention to those objects and events that correlate with our individual patterns of motivation and emotion. The stimulus factors of attention—intensity, duration, repetition, and so on—cannot hold us unless the events to which they attract us momentarily are interesting and motivating to us as individuals. The student who is easily distracted from his studying is probably not strongly motivated to continue.

Effective Displays. Any commercial enterprise which depends on attracting the public must not only attract them but be motivating enough to hold their attention. The ballyhoo of the carnival barker may stop patrons in their tracks, but he must have something further to show in order to lure them to his booth and keep them interested. Some perceptual situations, such as an art exhibition, a football game, or a good theatre production, will maintain directed orientation for an hour or more. Others, such as a dull lecture or a poor television program, will not sustain ordinary attitudes of alertness for more than a few minutes.

The requirements of a good display are based on the stimulus and motivating fac-

tors of attention as we have discussed them. To rephrase these conditions, we say that a display should have perceptual immediacy and perceptual distinctness, should create expectancy, and should be perceptually motivating. A display is perceptually immediate if it requires little thought or effort to understand it. Loud sounds, seminude figures, lots of color, and novel situations are good attractors because they are immediately perceived. An object or event is perceptually distinct if it stands out from its surroundings clearly. A new machine, a strange color combination, a blank page in an otherwise printed magazine, are flamboyant in being out of the ordinary routine and thus effective in attracting attention. Distinctness is often a matter of timing or of picking the proper time and place for making an announcement.

Displays which create an expectant attitude for something that is to come are establishing a preparatory set in the observer to attend to and perceive what follows. Preliminary announcements of important displays or warnings that a stop signal is coming up so create an alertness in the observer that he is not likely to ignore the coming event. As we have indicated above, displays are perceptually motivating if they take advantage of important human values and needs. Pictures of babies, pretty girls, appealing puppies, and deliciously prepared food are all attention getting.

There are several principles that should be followed if a display is to receive the sustained attention of observers. In the first place, the display should create a positive orientation instead of a negative one. Unpleasant or disturbing stimuli attract attention, but repel the observer. If disturbing stimuli or warnings are used to attract, these negative effects should be counteracted in order to maintain positive orientation. Secondly, if it is to maintain attention a display should be varied and animated in order to overcome monotony and boredom. In the third place, displays have greater lasting value if they are organized around meaningful adjustive patterns that are of significance to large numbers of people. Sports, soap operas, and motion pictures are based on patterns of activity and adjustment that express the needs and relieve the tensions of many observers. Finally, more sustained attention is given to objects and events that come to have individual identification. People come to identify themselves with a type of clothing, a make of automobile—even movie stars—if they have had numerous direct or indirect experiences with these perceptual objects.

In advertising, marketing, and communications research, many different objective measures are used to evaluate the psychological effects of different displays. *Legibility* is the degree to which the display can be seen or heard, while *intelligibility* represents the degree to which it can be comprehended. Other measures of a display are its *memory value* and *attitudinal effect*. The latter can be determined by surveying the emotional reactions and associations induced by the display. To measure emotional response, we record blood pressure, pulse, breathing rate, or the GSR. Eye movements also can be recorded to determine how long a person observes different parts of a visual display.

The type of display to be studied determines which of these different perceptual measures is most useful. Measures such as these are alike in providing quantitative data with which to evaluate a display or compare it with others.

THE WORLD OF FORM AND SPACE

We have seen that the reactions of attention are highly selective in picking out just what objects or relationships in the environment shall be perceived. As we learn more about the organization of our *perceptual world, we see that all perceptual* processes are selective. The perception of objects and form in space depends on our attending to and perceiving some stimulus relationships and ignoring others.

The selective nature of the attention-perception process is apparent both in our choice of a perceptual object out of a varied environmental field and in the actual perceiving of that object. The fact that we perceive an object instead of a meaningless jumble of stimuli involves the process of *figure formation,* in which certain stimuli in the stimulus field are attended to in order that the perception can occur.

The perception of form is not passive. Sometimes we may think that seeing an object is the direct result of the fact that it casts an image on the retina. However, the activity of the visual receptors is only the beginning. Visual perceptions involve the active participation of the behaving individual.

Some of the special problems connected with the perception of form are suggested by the visual arrangement in Figure 9.3. The overall pattern here is obvious. It is a picture of a jeweled lady talking. But it is made up of a large dashed triangle, a pincushion, and other simple arrangements of lines. Now the point about this drawing is that it is difficult to see the small parts as distinct objects. They are interrelated and organized to form a whole. The lady with the jewels is the perceived result.

The organization of perception into object patterns has many special aspects which take us beyond the simple notion of form as observation of an image on the retina. When we look at Figure 9.3, why don't we see the holes, the negative spaces, rather than the outline and details of a lady's head? Why do we fill in the missing parts of a pattern to complete a form? We give the lady in Figure 9.3 properties like movement and animation in talking that are not specifically included in the stimulation pattern. Perception is noted for this property of "filling in" empty gaps.

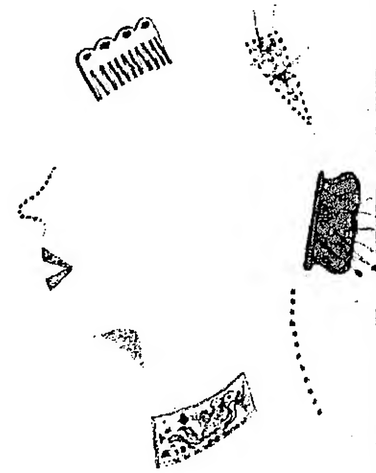


Figure 9.3. Perceptual organization. Perception is typically a positive organizational process in which objects, or total patterns, having behavioral significance are perceived. When we look at the details in the figure above, we perceive a jeweled lady talking, an organized whole.

Two-dimensional Figure Formation. Figure-ground formation is a fundamental aspect of all observation. Sometimes it is a function of *relative intensity* of stimuli. Single loud sounds stand out above other environmental noises and are observed as distinct auditory figures. In the same way a bright light in an otherwise dark visual field makes a distinct point or pattern that is observed against a background.

When we view complex forms like the jeweled lady, other critical factors besides relative intensity come into play in the formation of figure and ground. These factors are related to numerous stimulus differences within visual patterns, as well as to certain characteristics of the observer. Some of the stimulus factors influencing figure formation are shown in Figure 9.4.

Relative distribution of light within the total pattern of stimulus differences affects figure formation, as in the example given in Figure 9.4*a*. In the upper drawing, the black space between the R and J is not perceived as a figure but as part of the ground. However, in the lower drawing, the same black space stands out as a figure and the letters are difficult to see. Thus the

formation of figures depends upon the distribution of black and white in the entire rectangular pattern. The black area that is figure at one time is part of the ground in another pattern.

Anisotropy in perception refers to the fact that figure formation depends on lines of direction in visual patterns. Thus, in Figure 9.4*b* the sad face of the bearded man is seen readily, but if we turn the pattern upside down, we see the smiling face of a fat boy with a high collar.

The *relative location* of detail is important in the process of figure formation. The cherubs in Figure 9.4*c* appear as figures on a black ground with the black dots representing eyes. However, if the dots are covered, the entire pattern assumes the form of a black pedestal.

Relative density as a factor in figure formation is illustrated by the perception of the owl in Figure 9.4*d*. This effect is related to relative location of detail and intensity differences within the field.

Continuity and *movement* also are factors in the perceptual organization of visual figure. The continuity of certain lines in Figure 9.4*e* produces a chimpanzee.

Proximity refers to the nearness of stimulus patterns in the field. The formation of the flowerlike figure in the center of Figure 9.4*f* is the result of the closeness of the lines in this part of the pattern. Density and proximity are closely related factors.

Familiarity as a factor in figure formation is the result of prior perception and learning. The observation of ink-blot patterns, such as the one in Figure 9.4*g*, is a function of the factor of familiarity as well as of some of the other direct stimulus factors noted above. This blot is easily organized into a catlike form which stands out with noticeable depth.

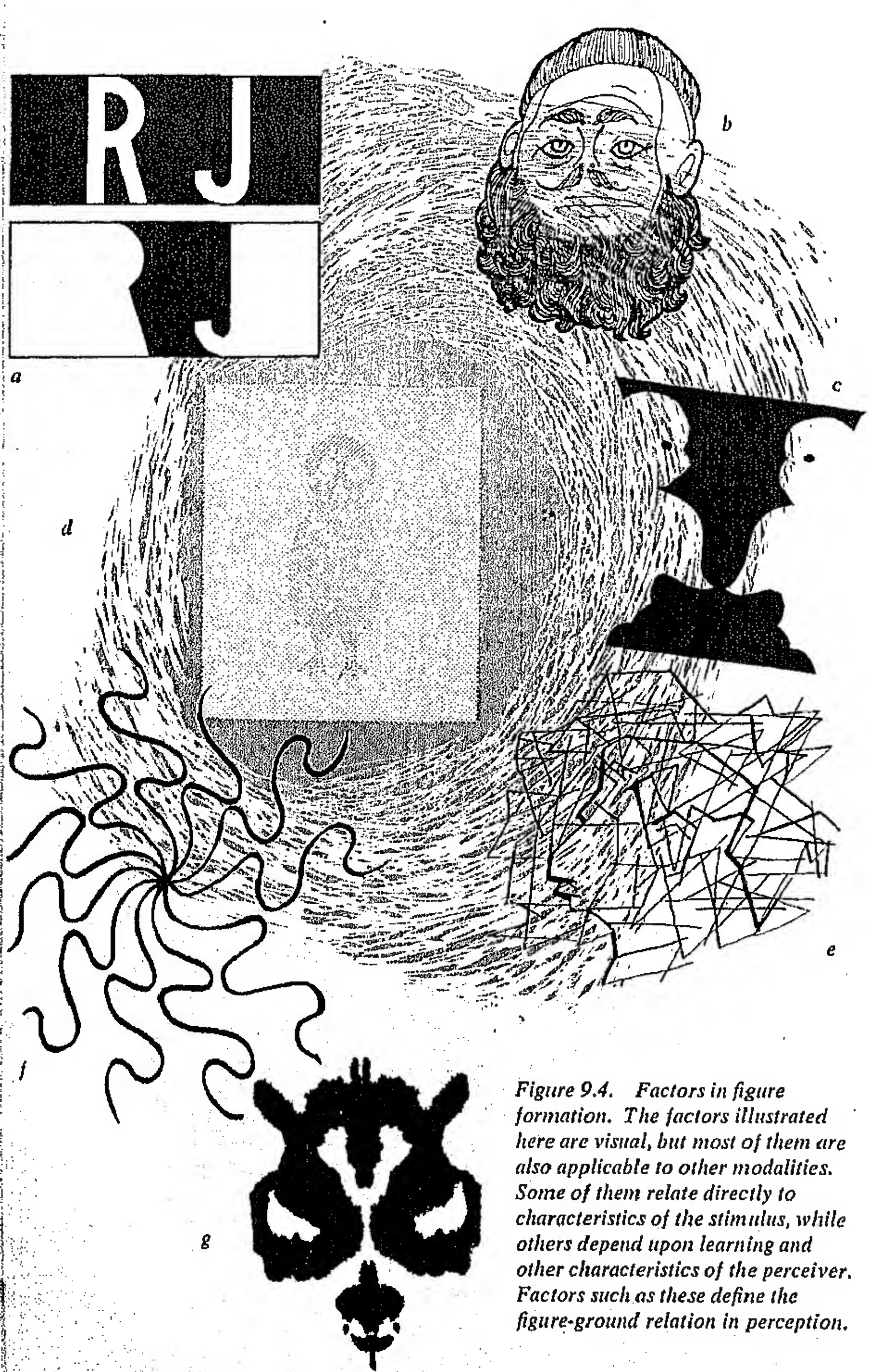


Figure 9.4. Factors in figure formation. The factors illustrated here are visual, but most of them are also applicable to other modalities. Some of them relate directly to characteristics of the stimulus, while others depend upon learning and other characteristics of the perceiver. Factors such as these define the figure-ground relation in perception.

Figural after-effects. Figure formation is a dynamic process of organization involving three main features: (1) the arrangement of stimulus patterns to constitute wholes, (2) spontaneous change in these arrangements in time, and (3) persistence of the perceptual effects after the stimuli initiating the process are removed. The second and third of these characteristics of dynamic perceptual organization also are illustrated by the phenomena of figural after-effects.

Spontaneous changes in figure formation can be demonstrated by looking intently at a slightly curved line for a minute or so. If we keep our eyes fixed at the center of the line, we will notice as time passes that the slight curve becomes less and less obvious. Finally the curve is not seen at all and the line appears straight.

The persisting effects of sustained stimulation, called *satiation,* can be demonstrated in the following way. Mark an X on a piece of paper and place a quarter to the left, with its center exactly 1½ inches from the X. Now stare intently at the X for a full minute. At the end of this period, immediately replace the quarter with a nickel and also place another nickel with its center exactly 1½ inches to the right of the X. Keeping your fixation on X, if you have followed these instructions carefully you will perceive the nickel on the left as somewhat smaller than the one on the right. Also, the nickel on the left may appear farther away from the X than the one on the right, and its edges less distinct.

Similar effects can be demonstrated in three-dimensional figure formation, a topic we shall take up shortly. If one fixates a convex surface for a short time and then shifts his view immediately to a flat surface, it will appear somewhat concave.

The particular processes of neural organization underlying figural after-effects are not fully understood, although the effects themselves are clearly demonstrable. However, these effects are undoubtedly due to unlearned organizational processes within the response mechanism. Figure formation is an active, changing process which, once established, persists in time and can affect subsequent figure formation initiated by new and different stimuli. These demonstrations of figural after-effects show clearly that perceptions in sequence are not independent. What is perceived now depends not only on memory, learning, and motivation, but also on the more immediate events of the figure-formation process within the individual.

Figural after-effects often are contrasted to after-images. The latter, as we shall see, are directly related to receptor processes, not to neural ones.

Camouflage. The factors and principles which define the formation of perceived figures also can be used to produce hidden figures and visual confusion. That is to say, by utilizing such factors as distribution, proximity, and density, it is possible to destroy figures normally present in perception. Such arrangements may involve differences in hue as well as in black and white.

Animal camouflage, such as that seen in Figure 9.5, operates according to definite principles of figural confusion. First, there may be resemblance in coloration to a particular background; second, the camouflage is based on disruptive patterning and countershading. The irregular patterns of color seen on some fish, birds, snakes, and mammals break up the regularity of the observed patterns of their bodies and thus make them inconspicuous.

Figure 9.5. Animal camouflage. Figural confusion is achieved by the protective resemblance of the tree frogs to their background. (From Hartley, P. H. T. Animal camouflage. *Endeavour,* 1948, 7, 97–103; courtesy the publisher.)

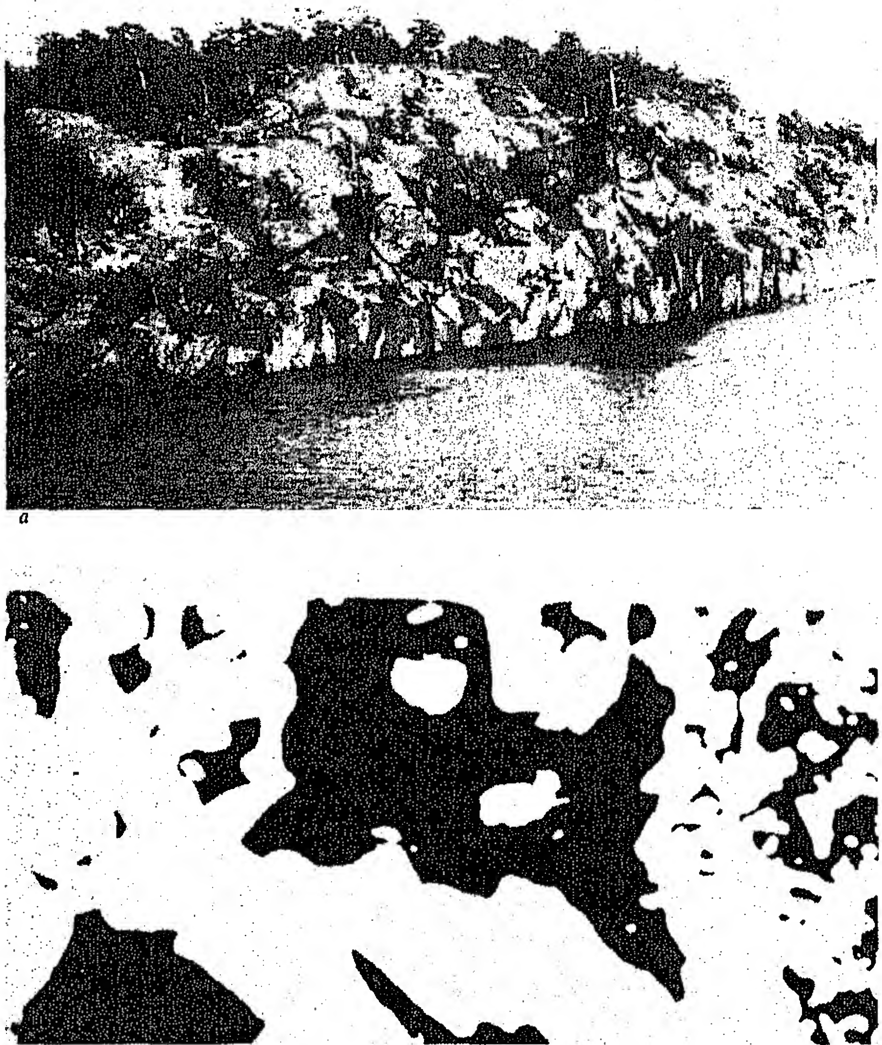


Figure 9.6. The destruction of perceptual figures. a. *Military camouflage makes use of the principles of figure formation to achieve visual confusion.* (Courtesy Svenskt Pressfoto.) b. *An example of a hidden figure depending upon a particular combination of factors of figure formation. This illustrates that familiarity is not as important in figure formation as we usually believe.* (From Porter, P. B. Another puzzle picture. *Amer. J. Psychol.*, 1954, **67**, 550-551; courtesy the publisher.)

Look at the picture of the Swedish island in Figure 9.6*a*. Can you see anything special about this island? If you are good at detecting details, you may be able to see the outlines of a ship located directly in front of the island. The fine camouflage effect involves destroying factors of familiarity, continuity, specific distribution, and relative location of stimuli in the total pattern of the ship and its background.

An excellent example of a hidden figure is seen in Figure 9.6*b*. In this picture can be seen a likeness of Jesus, although many people may have trouble finding it. This hidden figure effect is achieved mostly by the special distribution of light and shade and the factor of continuity in the pattern. Once a visual figure is perceptually organized, it is unlikely that the organization ever will be lost. Consequently, once we have seen the hidden figure in Figure 9.6*b*, we are not likely to "lose" it.

Gestalt psychology, which means literally the psychology of form, has sought to systematize the principles of figure formation into a general theory of behavior. One important principle of perceptual organization formulated in gestalt theory is that of *closure*. This principle states that any pattern, no matter how incomplete, will be perceived as an organized whole. In the perceived form, figure and ground will be organized to make up a total pattern that has unity. The jeweled lady in Figure 9.3 is an example of closure. Another principle of gestalt psychology states that perceptions tend to be as simple and "good" as conditions permit. Simple figures are formed in preference to complex forms.

Three-dimensional Figure Formation. The factors that operate to impart figure and ground to stimulus patterns in the percep-

tion of two-dimensional forms are also involved in the perception of objects and space in three dimensions. In any pattern of visual detail—no matter how complex, chaotic or random—the figure-ground effect will appear.

The usual figure-ground effect in two-dimensional forms actually entails some degree of depth perception. The figure stands out away from the ground, nearer the observer. To get a good example of this effect, turn back to the green moons seen in the hatful of illusions in Chapter 8. When the hat is moved, these moons seem to move above and independently of the surface of the red background.

Monocular factors in space perception. Some basic conditions for seeing three-dimensional objects and figures are illustrated in Figure 9.7. In Figure 9.7*a* we see two fields made up of patterns of lines. In the field to the left, the lines vary in size and separation, but in the field to the right they do not. The left diagram is perceived as having three dimensions—an area which recedes in the distance—while the right diagram appears as a flat surface of two dimensions. This depth effect can be seen with one eye if there is a figure-ground formation coupled with a systematic variation in stimulation, or a gradient of stimulation, within the perceptual field.

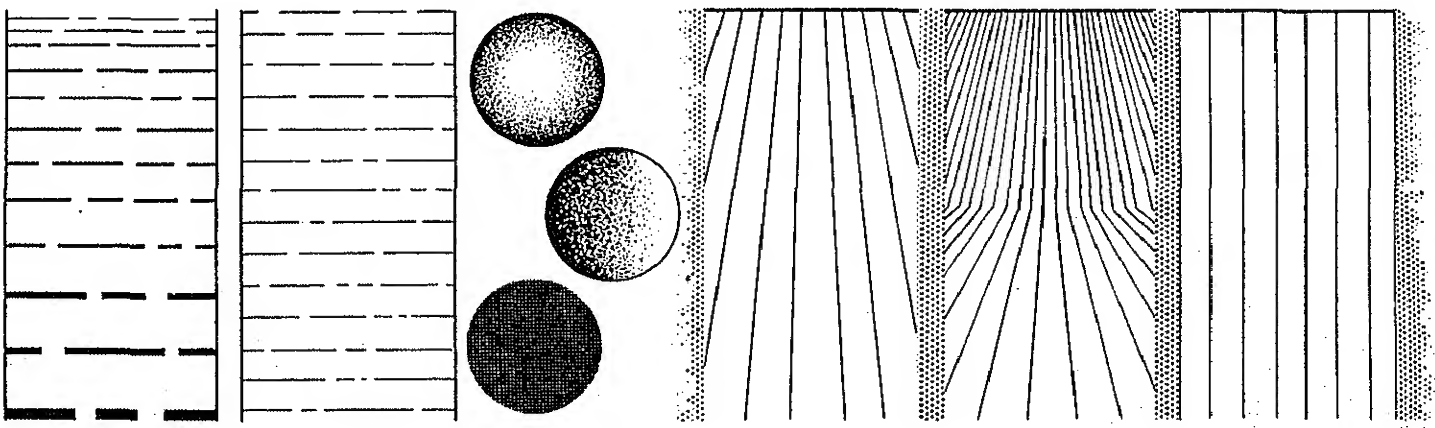
The diagrams in Figure 9.7*b* show how three-dimensional figure formation can come about as a result of a gradient in brightness. The two circles at the top show progressive changes in light intensity within the formed figures, and both of them appear to be spherical; the circle at the bottom, with no gradient of stimulation, is seen as flat.

The left field in Figure 9.7*c* gives a marked depth effect based on linear perspective, or a systematic variation in line direction within the formed field. The middle field shows a modification of depth with a sharp shift in the direction of the lines. The field to the right, having no variation in or gradient of line direction in the field, has no three-dimensional quality.

The primary basis of monocular depth perception is the formation of a figure on a ground coupled with a systematic variation in, or a gradient of stimulation within, the formed figure. The artist utilizes all the applications of this general principle in producing the illusion of depth on a flat surface (Fig. 9.8). Perhaps the most im-

Figure 9.7. Basic conditions for three-dimensional figure formation. Systematic changes or gradients in patterns of stimulation determine the perception of three-dimensional space. (Adapted from Gibson, J. J. *The perception of the visual world.* Boston: Houghton Mifflin, 1950.)

a *b* *c*



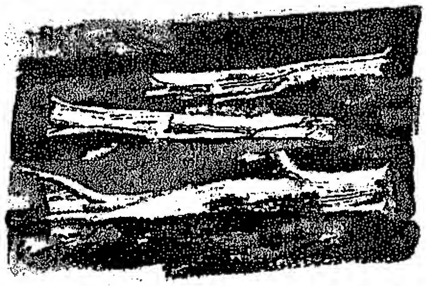


Figure 9.8. Monocular factors in space perception. The perception of space and three-dimensional objects does not require the use of two eyes. These paintings illustrate a number of monocular factors employed by the artist to produce the impression of solidity and depth. The fact that objects of equal physical size at varying distances produce images of different size on the retina accounts for linear perspective, and the related factor of relative size. The other factors illustrated are relative vertical position, aerial perspective, shadows, and overlay, the partial hiding of one object by another.

portant depth factor is *linear perspective*, or the decrease in apparent size of objects the farther they are from the eye. Parallel lines—the rails of a railroad track, or the top and bottom edges of a wall—appear to converge as they recede into the distance. Related to linear perspective is the factor of *relative size*. A house or tree in the foreground appears larger than a house or tree in the background. *Relative vertical position* refers to the fact that nearby objects are usually lower in the visual field. *Shadows* or *shading* are important in giving the feeling of depth to a flat picture. By *aerial perspective* we mean the blurring of objects in the background and change in color in distant landscapes. Finally, *overlay* or interposition means the partial hiding of a far object by one nearer to the observer.

All of these stimulus factors producing monocular depth perception operate in everyday life as well as in perception of pictures. In addition there is the very important factor of relative movement, or the difference in relative speed of near and far objects which are moving in the visual field. For example, when you are riding in an automobile, the telephone poles beside the road seem to flash by at a high rate of speed compared to the slower movement of more distant objects.

Binocular factors in space perception. The stereoscope is widely known as a device for seeing three dimensions in photographs. It is an arrangement by means of which two slightly different views of the same scene are presented separately to the two eyes. In our everyday observation of three-dimensional space, as well, our two eyes get separate images of the visual environment, and as a result of integration of these two separate stimulus patterns, a

binocular or two-eyed depth effect is achieved. *Binocular disparity* operates in conjunction with the stimulus factors of monocular depth perception to produce our three-dimensional space.

The photographs in Figure 9.9 were taken with a stereoscopic camera. If you examine them, you will see that they present views of the same scene from slightly different angles. Place a piece of cardboard at least twelve inches long upright between the two pictures and rest your head upon it so that your right eye sees the picture on the right and your left eye, the picture on the left. In this way you should be able to see the two separate pictures as if they were one view with depth.

The principle of binocular disparity is diagrammed in Figure 9,10*a*. Here it can be seen that the image of the pyramid on the right retina differs slightly from the image on the left retina. With binocular vision we get a front view of the object plus a partial view of each side. Since binocular disparity depends upon two disparate retinal images, it is effective only in those parts of the visual field that are projected simultaneously on both eyes. However, only the central part of the visual field is seen binocularly. The far right and far left areas of the field are projected only on the right eye and left eye respectively. These relationships are diagrammed in Figure 9.10*b*.

Human vision is superior to that of all other animals with respect to the amount of binocular overlap; that is, a larger percentage of the visual field is projected on both eyes in human vision than in that of lower animals, although the higher monkeys and some apes approach man in this respect. In some animals, such as the squirrel, there is no binocular overlap. In these

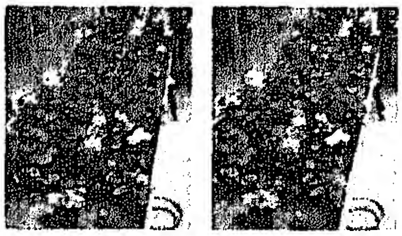
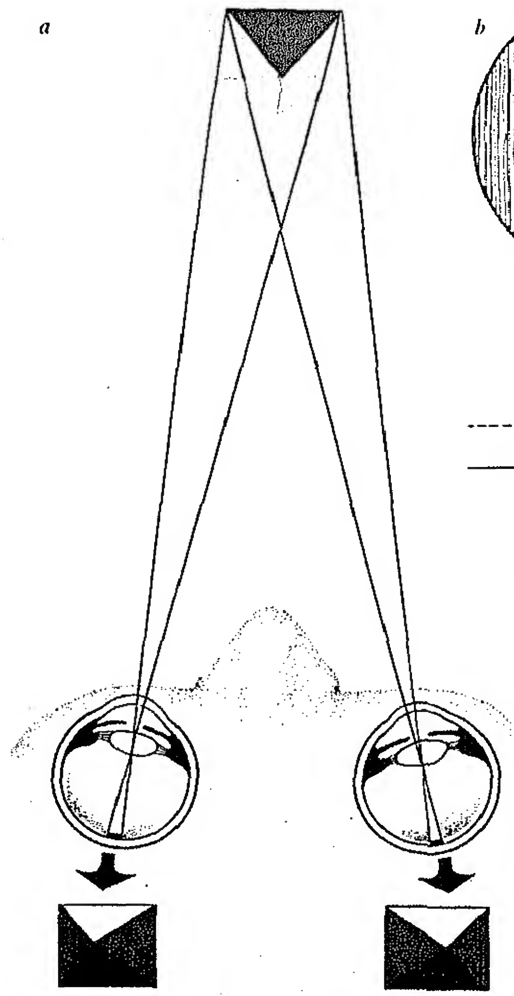


Figure 9.9. Stereoscopic photographs. Place a piece of cardboard at least twelve inches long upright between the two pictures and rest your forehead upon it so that one eye sees each picture. You should be able to fuse the two pictures into one view with apparent depth. (Courtesy W. W. Garstang.)



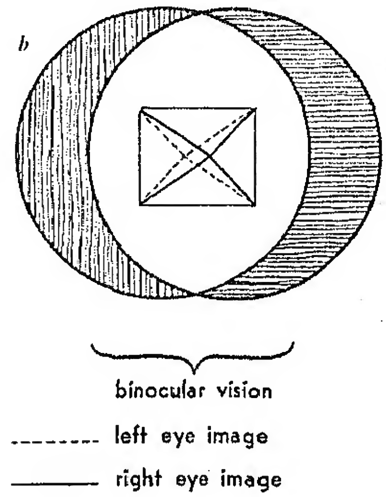


Figure 9.10. The principle of binocular disparity. The most important factor in perception of three-dimensional space is binocular disparity, the slight difference that exists between the stimulus patterns in the two eyes because of the separation of the eyes, a. *Only the central area of the visual field is seen binocularly,* b; *the lateral areas are seen monocularly. Also, as the distance of observation increases, the amount of binocular disparity decreases, until at several hundred yards this factor becomes negligible.*

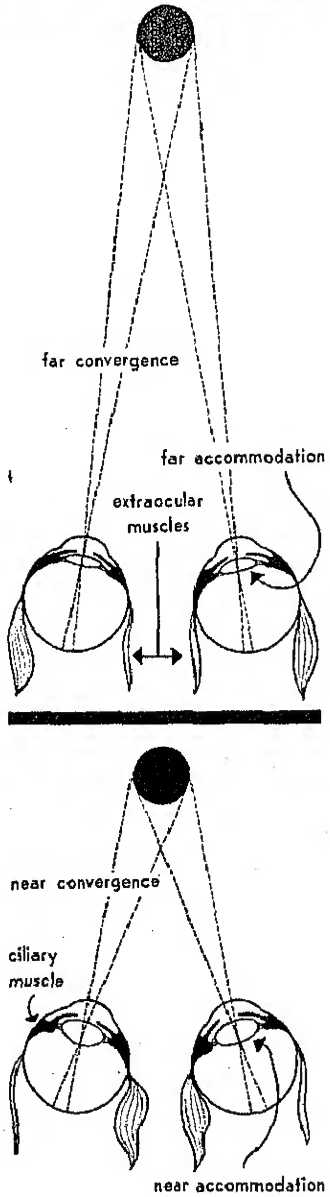


Figure 9.11. Kinesthetic factors in depth perception. Patterns of accommodation and convergence of the eyes provide kinesthetic cues which aid in perception of depth and distance.

animals, visual depth perception is dependent on monocular stimulus factors.

The factor of binocular disparity is most useful in the perception of depth at relatively short distances. As we observe objects at a distance, our eyes move into an essentially parallel position and the two retinal images become practically identical. The distance at which binocular disparity becomes ineffective varies from several hundred feet to perhaps two or three thousand feet under optimal conditions of observation. Since our perception of three dimensions depends on the monocular stimulus factors as well as on binocular disparity, the gradual loss of the binocular factor with distance is usually unimportant.

Interplay of sensory systems in space perception. Our perception of three-dimensional space is not only visual but depends also on kinesthetic, cutaneous and auditory stimulation. Especially important in depth perception are the kinesthetic cues provided by *accommodation* and *convergence* of the eyes.

Accommodation, as shown in Figure 9.11, is the process of adjustment of the lens of the eye through the action of the ciliary muscle, a circular muscle surrounding the lens inside the optic globe. When the ciliary muscle contracts, it counteracts the pull of the optic globe on the lens and thus allows the elastic lens to thicken for near vision. When the ciliary muscle relaxes, the pull of the optic globe on the lens causes it to flatten out for perception at a distance. Convergence of the eyes depends on action of the ocular muscles on the external surfaces of each eye. As shown in the figure, the muscles on the nasal (toward the nose) part of the two eyes are sharply contracted in near vision, while in far vision, the temporal or outside muscles are contracted. Sensory impulses from the kinesthetic receptors in the ciliary and extraocular muscles give information about patterns of accommodation and convergence, and thus contribute to the perception of depth and distance.

In addition to visual and eye-muscle stimulation, we receive information from other kinesthetic receptors and from cutaneous and auditory receptors to add to our knowledge of three-dimensional space. Auditory stimulation of the two ears tells us something of the direction, distance, and movement of sounds. Although in people with normal vision, auditory factors usually play a secondary role in perception of space, the auditory discrimination of spatial relationships is usually very keen in the blind.[4] As an individual approaches an object, sounds of his footsteps and other body movements are reflected or bounced back to his ears. A blind person is very skillful in avoiding obstacles on the basis of the changing characteristics of the reflected sounds. People with normal vision can learn to avoid obstacles while blindfolded, but require considerable training to become as proficient as the blind.

Stereophonic sound production is an artificial means of creating realistic depth effects in sounds and music. The principle involved is very similar to that of stereoscopic vision. By special recording procedures and reproduction through two speakers in the same room, time and intensity differences in the two sound sources produce auditory space effects.

The different receptor systems of the body are integrated both in perception of space and in regulation of movement in space. It is imperative for normal space perception and orientation that such integration occur. Kinesthetic space must cor-

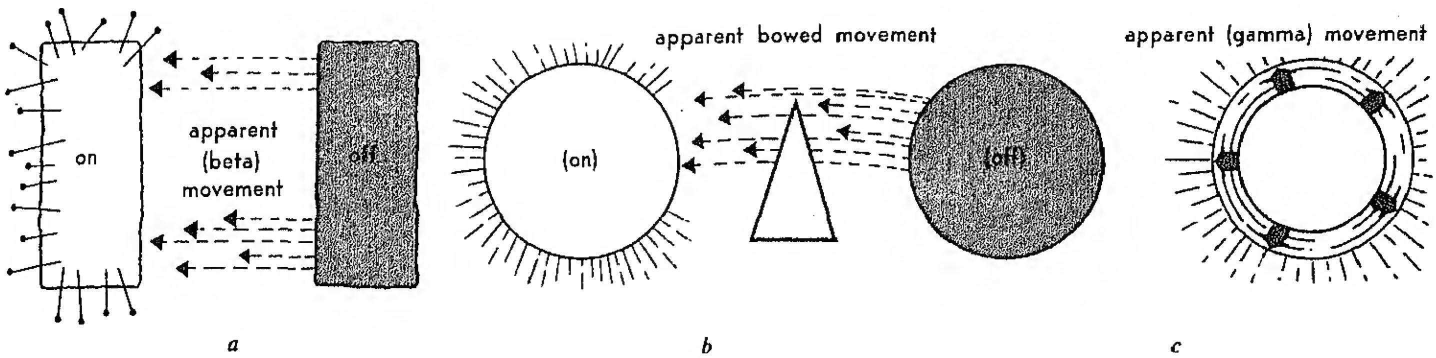


Figure 9.12. Forms of apparent movement. Perceived movement is sometimes seen although there is no actual displacement of a stimulus object. Beta movement is the sort of apparent movement seen in motion pictures and neon signs. If an object is placed between two flashing lights, we can see apparent bowed movement. Gamma movement refers to the momentary perceived increase in size of a light just turned on.

respond to a high degree with cutaneous and visual space. Cutaneous space must have common points with visual space. There is no doubt that the great elaboration of the human cerebral cortex is related to this interplay of receptor systems in space perception and to the control of three-dimensional motions. The investigations of inversion in the visual field (page 227) and deprivation of pattern vision in infancy (page 128f.) both suggest the importance of the integration of different sensory systems in defining the overall nature of space perception and of motions in space.

Perception of Movement. One of the most difficult problems in the whole field of perception is to understand the nature of perceived movement. Perceived movement of an object in space does not necessarily correspond to physical movement of the object. For one thing, whether we see movement of an object or not depends in part on the perceived movement or nonmovement of our own bodies. Also, we often perceive movement in the environment which is "apparent," not "real." It was the study of perception of apparent movement which led Wertheimer to formulate the principles of gestalt psychology, emphasizing the total organization of the perceptual processes. The older psychological notion of perception as a combination of discrete sensations is especially inadequate in explaining perceived movement.

By apparent movement, we mean perceived movement in which neither the observer nor a stimulus object actually changes position in space in a continuous way. We are all familiar with apparent movement of neon signs and of motion pictures. What is flashed on the movie screen is a sequence of single pictures, each separated in time from the next by a very brief dark interval. If a moving object is photographed about twenty times per second, its movement is represented by successive displacement of its image from one picture to the next. Now when these pictures are projected on the screen at about the same rate, we perceive the continuous displacement of the object from frame to frame as smooth movement which looks no different from ordinary movement of an object. The movement perceived in an animated neon sign is produced by the successive illumination of different elements in the sign.

Several types of apparent movement are diagrammed in Figure 9.12. Beta movement is the sort of movement we see in motion pictures and neon signs. When the two rectangular lights in Figure 9.12*a* are flashed alternately at the proper rate, we see a light which appears to move back

Figure 9.13. Perceptual constancy. Our perceptions of the objects and relationships in this photograph do not correspond exactly with the actual stimulus patterns. Under ordinary conditions, marked variations in size, wavelength, intensity, and form may not be responded to, as we perceive a world of constant objects.

and forth as shown by the dashed lines. This form of apparent movement also is known as the *phi phenomenon*. If an object is placed between two flashing lights, the apparently moving light, instead of moving directly across the space between the two lights, appears to curve around the front or the back of the stationary object (*b*). In Gamma movement, the size of a lighted disk or object seems to increase in size soon after the object or light has appeared (*c*). This "outward" movement or growth lasts only momentarily.

Another interesting type of apparent movement is *autokinetic movement*. If a small, stationary point of light is presented to an observer in an otherwise dark room, the light is seen as moving erratically about. This effect is not due to eye movements.

The perception of apparent movement depends upon the intensity of illumination and, in the case of Beta and bowed movement, upon the distance between the flashing lights and the time interval between successive flashes. Beta or bowed movement also can be seen when one light is observed with one eye and the second with the other eye. This fact shows that the phenomenon is not due to retinal processes.

Perceived movement across the surface of the skin can be demonstrated with tactual stimuli. By careful arrangement of two tactual stimuli, movement around the body—e.g., from stomach to back—can be perceived as well as movement "through" the body.

The processes by which we see apparent movement are not greatly different from those perceptual processes that inform us of the real movement of an object in space. The stimuli that supply the information to the receptor organ set up discrete neural processes which do not correspond in any way to movement in the environment. Under certain stimulus conditions we perceive movement, under others we do not. Sometimes our perceptions correspond with "real" movement and on other occasions they do not. Once again we are reminded of the difficulty in distinguishing between illusory and nonillusory perceptions.

PERCEPTUAL CONSTANCY

In vision, the pattern of light received by the eye from a particular object undergoes continual change. As the observer or the perceived object moves about, the size, shape, position, intensity, and wavelength

composition of the stimulus pattern shifts and varies, but the object is perceived as the same. A pretty girl in a large green hat maintains her identity in form and facial complexion even when she changes her green hat for a red one. This perceived identity is remarkable indeed when we consider that the dominant wavelength of light reflected from her face may have shifted from green to red with the change in hats. The stability of perception in the presence of change in physical stimulation is called *perceptual constancy*.

Perceptual constancy is the psychological integration of the microscopic detail of the physical environment. Chaos and confusion would mark our lives if we were forced to respond to every minute change or j.n.d. in stimulation affecting the receptor surfaces of the body. To live, the individual must organize the detailed changes in stimulation into a world of constant objects.

Some of the constancy effects in visual perception are seen in Figure 9.13. In this photograph the two blue balls appear to be of the same size, hue, and brightness, although there is much stimulus variation in all three qualities. The figurines in the foreground are perceived as being the same size as those in the background. The colors on the gourd, plate, and pitcher retain their constant appearance in spite of radical changes in stimulus energies. We see the plate as round, although the outline presented to the eye is that of an elliptical figure.

Perceptual constancy is a basic attribute of all modes of perception. An apple in the hand is observed as the same apple even as it is eaten and its physical contours vary. A song played in a different key or tempo is recognized as the same song notwithstanding the audible variations made in it. However, perceptual constancy is not absolute. Although the perceived size of an object does not vary directly with the changing size of the retinal image, neither does it remain absolutely constant. A man seen 300 feet away does not look quite as tall as he does at 30 feet. Constancy effects represent a compromise between the properties of stimulation and the ideal unity of the perceptual object.

Perceptual constancy begins to break down when perception is restricted in time or in space. If we view our visual field through a small aperture (try rolling up a piece of paper to make a viewing tube), we may pick up variations in size, form, brightness, and hue which ordinarily go unnoticed. A person seen from a second-story window presents a foreshortened view which is ordinarily unnoticed, but the same type of distortion on a small television screen cannot be ignored. If we took color photographs of the girl in her red and green hats, we would be surprised to see that her complexion actually does change from reddish to greenish hue. The variations that are not perceived in a normal perceptual field become obvious under restricted conditions.

The phenomena of perceptual constancy are not due to any single psychological process, but to many organizational processes in behavior. Any condition that favors figure formation in perception increases the degree of constancy. Stimulus factors which contribute to figure formation or to figure-ground relations in three dimensions increase the stability of the perceived forms. Then, too, the attitude of the observer is a critical factor in constancy. The commonplace attitude of reacting to objects in terms of their practical

value enhances the stability of our perceptions of these objects. A 100-dollar bill can have its physical features changed considerably by use and age without altering one whit its unmistakable identity. But let the attitude of the observer change to one of critical appraisal, and the variations in the bill will be perceived. Thus a critical owner of a worn-out bill might take it to the bank for a new one. Another critical observer will try to avoid the side seats in a theater because he cannot perceive the distorted figures on the screen as having a constant identity with living people.

The performance of many skills involves a dual attitude in perception—one enhancing and one destroying constancy. The oil painter at work must take an analytic attitude to control his technical skill in putting each brush stroke on his canvas. Like Cézanne he may maintain this attitude for days in balancing the color of each stroke with every other patch of color in the scene. But this sustained critical discrimination of every variation in color is guided by an overall perception of the total scene. The excellence of the work in the eyes of others depends on this total effect.

We have seen that perceptual constancy is influenced by stimulus factors and individual attitudes. It depends perhaps most of all on learning. Our knowledge of perceptual objects is made up of all the experiences we have had with those objects. Every time we see, hear, taste, smell, touch, or handle an object we learn more about its identity. The amount of detailed information we acquire contributes directly to the constancy of the perceived object. The fixed identities of wives, husbands, children, houses, and often-used possessions have a psychological foundation in perceptual experience and learning.

THE VISUAL WORLD OF LIGHT AND COLOR

The visual world is more than the variations of forms in space. The individual moves in a perceptual realm in which the spectral events of hue and color are perceived both for their light value and for their significance as blood, as lips, as eyes, as sky, as trees. In man's adjustment, colors mark the crossroads of life: blue and pink for birth, white for marriage, red for passion, danger, and damnation, and black for death.

The ability to discriminate differences among light waves is an age-old possession of animal life. The vital economy of the social life of bees is based on the perception of the hues of the spectrum. Fish, reptiles, and birds not only see color but match the hues of their bodies to the light pattern of the environment. Color is a device in nature to repel, to hide, to attract, or to extend the capacity of the roving organism to fit itself to the demands of the environment. Animals that can discriminate the wavelengths of the spectrum are more efficient in identifying enemies, in seeking food, and in protecting their kind from danger. Man has changed the use and application of color, but he cannot change its origin and nature. It is this problem with which we are concerned—the origin and nature of color as we perceive it.

Perception of the Visible Spectrum. The eye is sensitive to wavelengths of radiant energy between approximately 380 and 760 millimicrons (one millimicron or $m\mu$ = one millionth of a millimeter). As we learned in Chapter 8, we have one set of visual receptors—the rods—which discriminate no qualitative differences on the

basis of wavelengths, but enable us to perceive differences in brightness. Our other visual receptors—the cones—enable us to perceive the hues of the visible spectrum (Fig. 9.14). Thus we say that we see two types of color: the achromatic colors of black, grays, and white, and the chromatic hues of red, orange, yellow, green, blue, and violet.

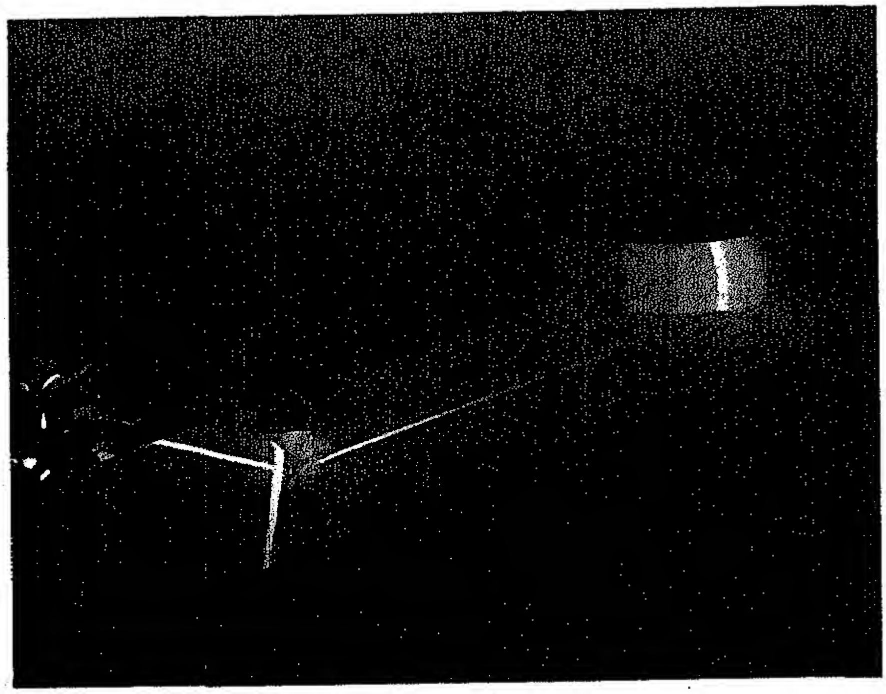
Chromatic and achromatic sensitivity. As we indicated in Chapter 8, the rods are sensitive to much lower intensities of light than the cones. If we reduce the intensity of a chromatic visual stimulus such as orange, we reach a point at which the orange chroma can no longer be seen. At intensities below this *chromatic threshold* the cones are not stimulated, but the rods still are sensitive. Since the rods do not give us perceptions of chroma, the orange stimulus is perceived as gray. If we reduce the intensity of light still further, we reach the *achromatic threshold,* or the absolute threshold of stimulation of the rods below which our visual receptors are not sensitive to light.

Not only are the rods and cones different in absolute sensitivity, but they are *selectively* different in sensitivity to different wavelengths. Although these two kinds of visual receptors react to approximately the same spectrum, the rods are relatively more sensitive to short wavelengths than the cones (at the violet end of the spectrum), while the cones show approximately the same sensitivity as the rods at the red end of the spectrum (Fig. 9.15). In addition, the point of greatest sensitivity for the cones is in the greenish-yellow region of the spectrum, and at the region corresponding to green for the rods. Thus, as the intensity of illumination is reduced and our eyes shift from cone to rod vision, the region of the spectrum to which we are most sensitive shifts from greenish-yellow to green. This is known as the *Purkinje shift.* It accounts for the visual effect that is noticeable at twilight or in the reduced illumination following a storm. If we look closely at the colors of the countryside as twilight sets in we observe that the reds and oranges become dull and that the greens of the trees and grass appear brighter. As the illumination decreases still more, the chromatic colors gradually fade out and we perceive only shades of gray.

Visual acuity. Our visual environment is made up of complex patterns of light waves, either given off directly from sources of light or reflected from surfaces in the visual field. We appreciate the rich detail of our world by our ability to discriminate differences in brightness and differences in hue and to resolve these differences as they exist spatially; that is, not only do we see many variations in color, but we see them in precisely defined patterns. The resolving power of the visual system, or *visual acuity,* is measured in terms of the ability of the eye to distinguish fine detail in the visual field. It varies with different wavelengths, being best for light seen as white and yellow. Our acuity for black and white patterns is usually superior to that for other combinations of colors (Fig. 9.16).

Color Zones of the Visual Field. The perception of hues is not uniform throughout the visual field. The reason for this is that the receptors for chromatic vision—the cones—are not distributed uniformly in the retina or throughout the full extent of the retina.

The color zones of the retina can be mapped out by the method shown in Figure 9.17. One eye of the subject is covered



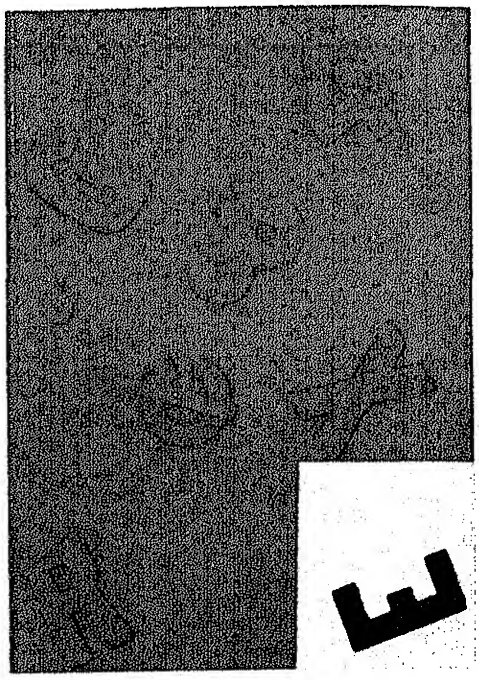


Figure 9.16. Visual acuity as affected by hue. The ability of the visual system to distinguish detail is better for the black letter on a white ground than for the green figures on red. You can confirm this by looking at the figure from a distance.

Figure 9.14. The visible spectrum. The prism spreads a narrow band of white light into the colors of the visible spectrum. White light is composed of discrete wavelengths of electromagnetic energy, which are perceived as distinct hues. (Reproduced, with permission, from the Kodak Data Book. *Color as seen and photographed.* Rochester: Eastman Kodak Co., 1950.)

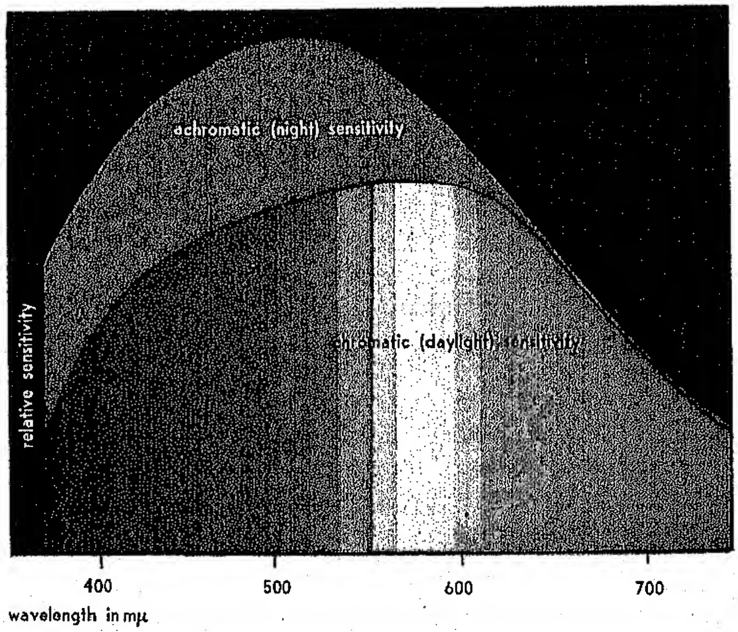


Figure 9.15. Relative sensitivity of the rods and cones to different wavelengths. The cones, which provide our perceptions of hue, are most sensitive to the yellow region of the spectrum, while the rods are most sensitive to those wavelengths corresponding to green. The rods are relatively more sensitive throughout most of the visible spectrum.

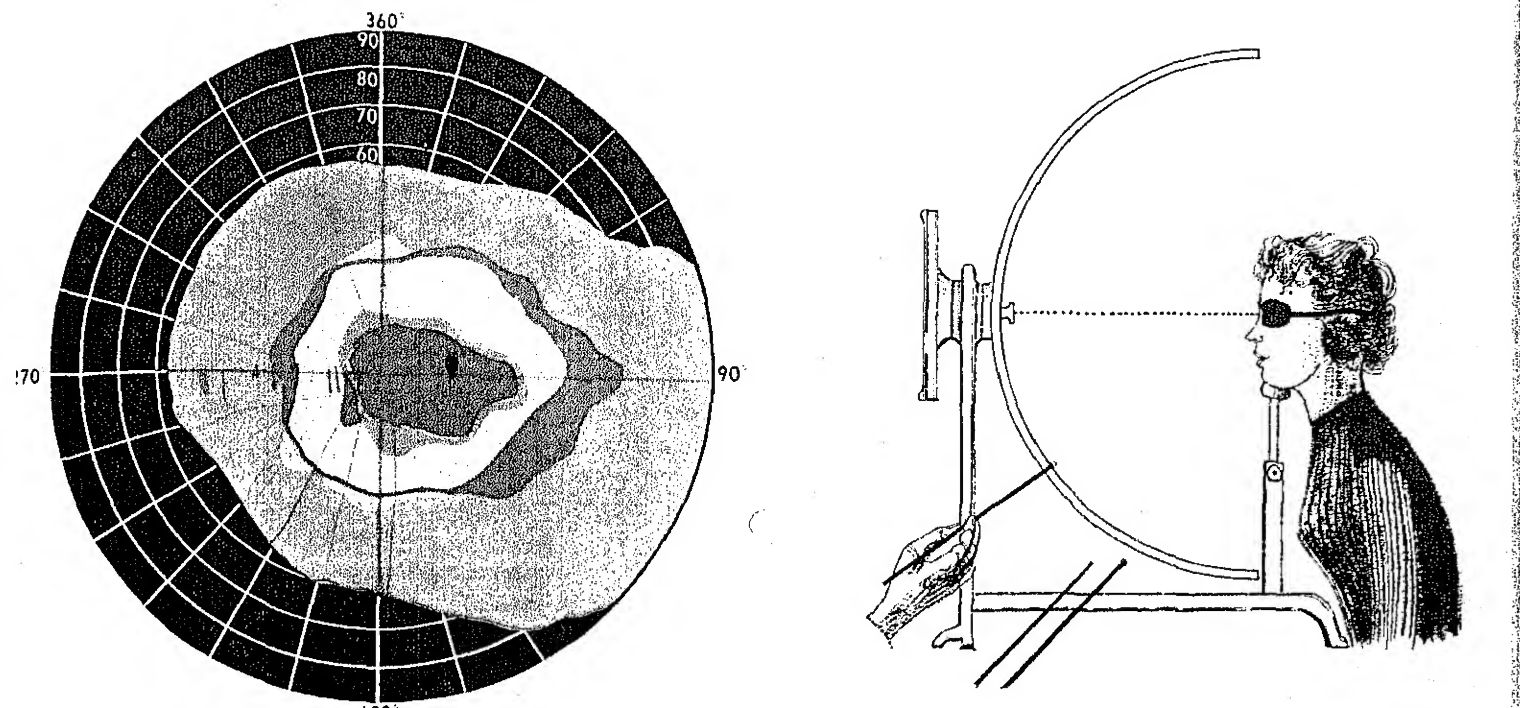


Figure 9.17. The color zones of the retina. The distribution of visual receptors in the retina defines specific zones in which different colors can be seen. By means of a perimeter, these zones can be mapped out. The figure shows a typical map for a right eye, with the limits of perception of green, red, yellow, blue, and brightness indicated. The dark spot in the green area is the blind spot. (From Committee on Colorimetry, Optical Society of America. *The science of color.* New York: Crowell, 1953.)

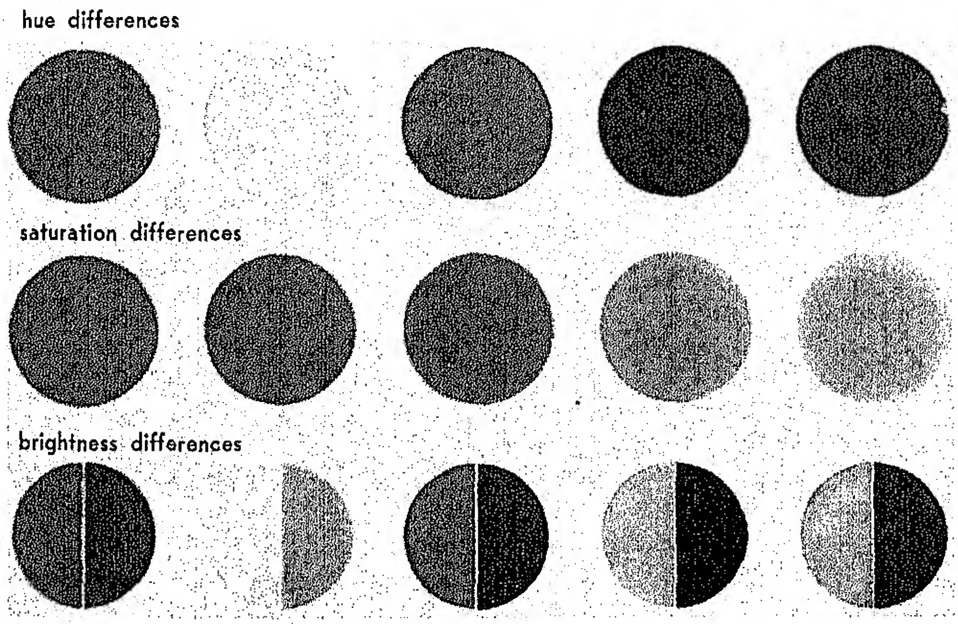


Figure 9.18. The psychological dimensions of color. Perceived colors vary in hue, saturation, and brightness. Each dimension can vary independently of the others, and all possible colors can be defined in terms of these three variables.

while the other fixates a white spot at the center of the visual perimeter. The arm of the apparatus, which forms a 180-degree arc about the eye as the center, may be set at a vertical position, as shown in the figure, or at any other desired position—horizontally or diagonally. The experimenter uses small pointers, fitted with tiny colored patches, to explore the limits of perception of particular colors at different angular positions.

The colored diagram in Figure 9.17 shows fairly typical limits of the color zones of the visual field for a right eye. The dark spot represents the blind spot. As a practical matter it is important to know that green and red colored signals cannot usually be seen in their true colors nearly as far into the peripheral visual field as colored signals of yellow and blue. The sizes of the different color zones of the visual field are not fixed absolutely, but are measured differently with changes in the size of the stimulus patch, its brightness, and the level of illumination at which the tests are run. Also, the general condition (e.g., fatigue) of the observer can alter the limits of these zones.

The perimeter or some modification of it has been used to study theoretical problems of color vision.[5] Needlelike beams of light of a very limited band of wavelengths were used to stimulate extremely small spots on the retina. In this way it was thought that specific cones could be stimulated. When a stimulus of a constant wavelength composition was directed at different points on the fovea it was found that the perceived hue changed. For example, a stimulus that usually appears orange appeared red in some points and pale orange in other points. White light might appear red, green, or blue, depending on the point stimulated. In contrast to other facts which suggest that there are three types of retinal cones determining color vision, these observations have led to the belief that there are as many as seven different types of cones responsible for defining the perception of hues.

Comparing and Measuring Colors. Because many different industrial and artistic activities require accurate reproduction of perceived colors, there is both a theoretical and a practical interest in the measurement and comparison of color stimuli. The three sets of patches in Figure 9.18 illustrate three ways in which colors vary psychologically: in *hue,* in *saturation,* and in *brightness.* Hue, or chroma, is what we know as spectral quality—red, orange, yellow, and so on. Saturation is the amount of color or chroma, and is shown in Figure 9.18 as the variation in the amount of redness from a vivid red to a medium gray. In preparing this saturation dimension, the effort has been made to keep the five samples at approximately the same brightness. We show the third mode of variation in color—brightness—in the paired samples of the same hue. Brightness is the psychological intensity or apparent luminance of colors.

We produce differences in hue, saturation, and brightness of colors by varying the different properties of the visual stimulus. As shown in Figure 9.19, a visual stimulus can be changed by adjusting the wavelength, the intensity, or the purity of the light source. Purity is defined as the ratio between the amount of the chroma-producing component in a light source and the white-light component.

Hue, saturation, and brightness vary with all of the physical properties of light,

but some of these relations are more decisive than others. Hue varies more with wavelength than with the other properties of light; thus changes in wavelength produce well-defined changes in hue. Brightness varies with both intensity and wavelength in a very marked way, and the saturation of colors can be changed by varying any of the physical characteristics of the light sample.

If we mark off the number of discriminable steps (j.n.d.'s) in hue in the spectrum, as well as the number of discriminable steps in saturation and brightness of each of these hues, we find that there are hundreds of different colors that can be distinguished. The problem of identifying and specifying any one of these colors, or a color sample of cloth, paper, or dye which will match it, is an important technical problem in visual science. There are two ways of specifying the many differences in hue, saturation, and brightness; they are by means of psychological description and by means of physical or color-stimulus specifications.

Figure 9.20 illustrates one system of classifying all of the variations in hue, saturation, and brightness on a color solid. In this double cone, variations in hue are represented on the outer circumference, variations in saturation are represented from the central axis outward, and variations in brightness are represented from top to bottom. The spectral hues plus extra-spectral purple appear along the central circumference. White is at the top of the solid and black at the bottom; thus the vertical axis represents a series of achromatic grays from white to black. Any color can be located in such a color solid at a point corresponding to its hue, saturation, and brightness.

Color Mixture. Every artist or do-it-yourself home painter knows how to mix paints to get a variety of different colors from a few basic pigments. What many of us do not know is that mixing paints is a special kind of color mixture differing from the usual kind of color mixture—the mixing of lights—found in nature. In visual science when we speak of color mixture we usually mean the mixing of lights of different colors. Mixing lights and mixing pigments to produce different colors follow different rules and produce different effects.

A technique for studying mixture of lights is shown in Figure 9.21. Three different projectors are used to shine three differently colored light beams on a reflecting surface. When the reflected beams overlap in part we get a mixture of each pair as well as a mixture of all three at the center. The resulting colors depend in part on the intensity of the beams of light as well as on their wavelengths. Using a controlled procedure of this sort we can reaffirm the principles which have been known since the time of Newton as the laws of color mixture.

The first law states that there are three primary hues which when mixed in proper proportions will produce any other color of the spectrum, including white. The white area in the center of the overlapping pattern in Figure 9.21 represents a mixture of a primary red, a primary green, and a primary blue. Any color can be matched by mixing the three primary wavelengths in proper proportions. This mixture can then be expressed as a color equation.

The second law of color mixture is known as the law of complementaries. For each perceived hue there is another hue which when mixed with the first in proper proportion will produce gray. We can

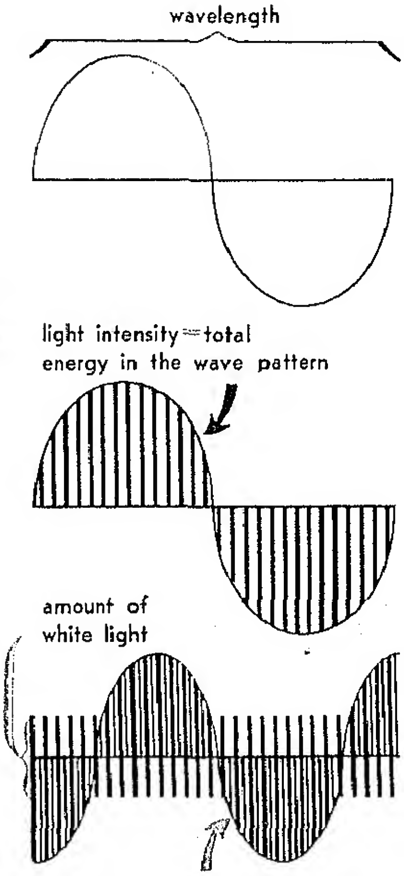


Figure 9.19. Physical variations in the visual stimulus. Light can vary in wavelength, in intensity, and in purity—i.e., the ratio between the amount of the chroma-producing component and white light. Hue varies principally with wavelength, brightness varies with both intensity and wavelength, and saturation is changed with variations in any of the physical characteristics.

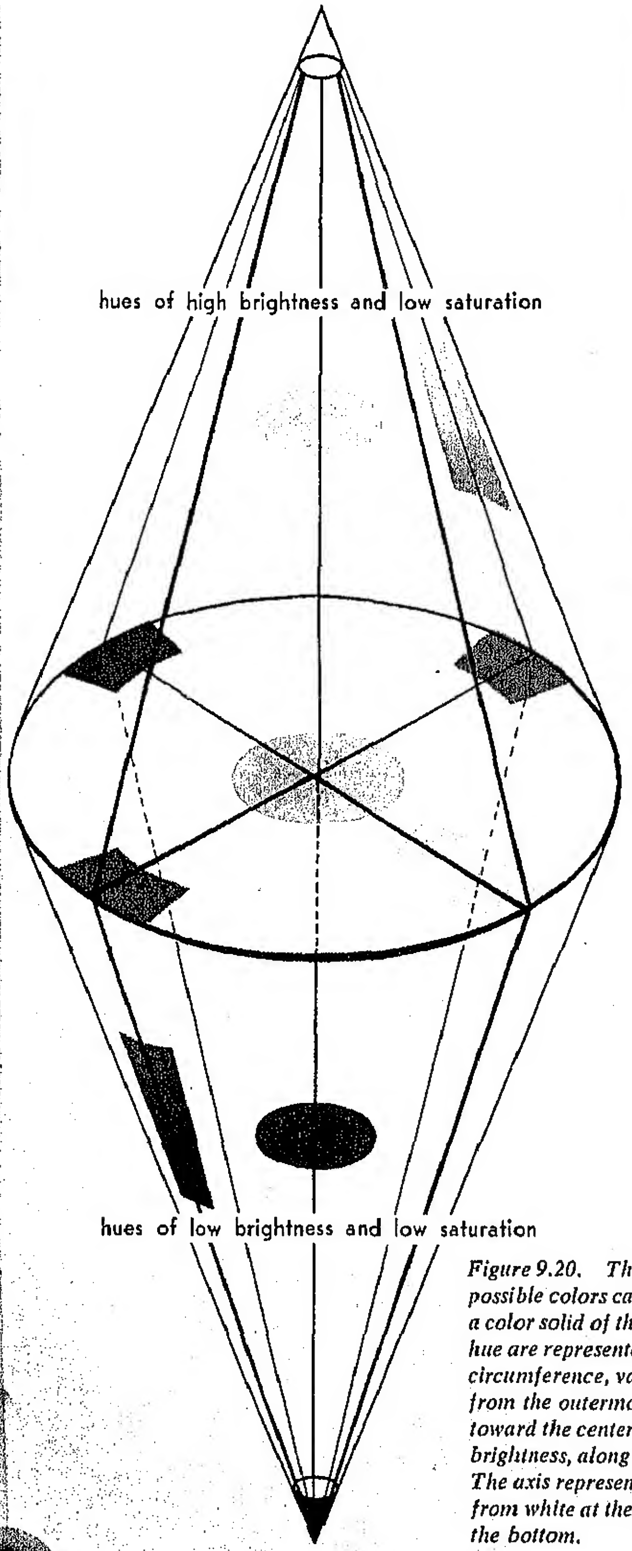


Figure 9.20. The color solid. All possible colors can be represented on a color solid of this sort. Variations in hue are represented around the circumference, variations in saturation, from the outermost circumference toward the center, and variations in brightness, along the central axis. The axis represents the gray series, from white at the top to black at the bottom.

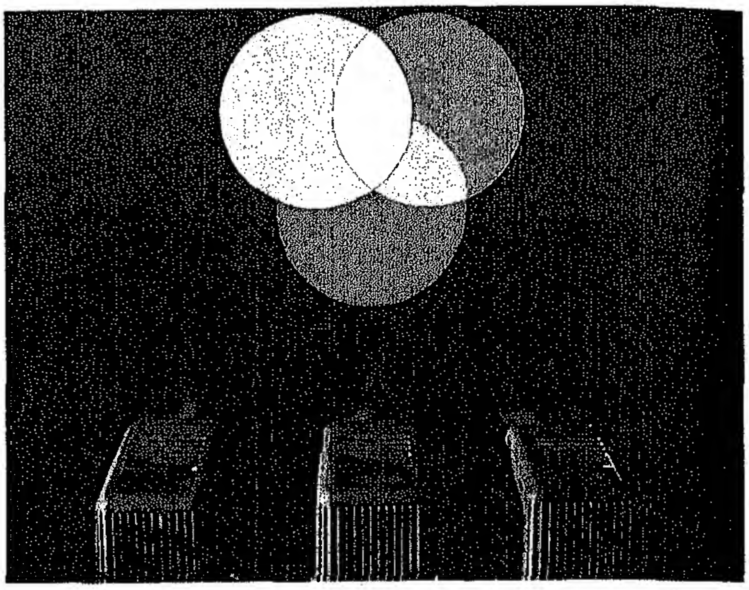
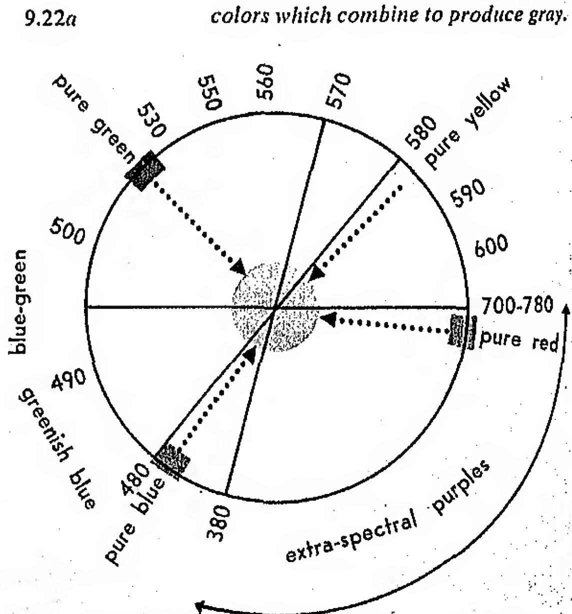
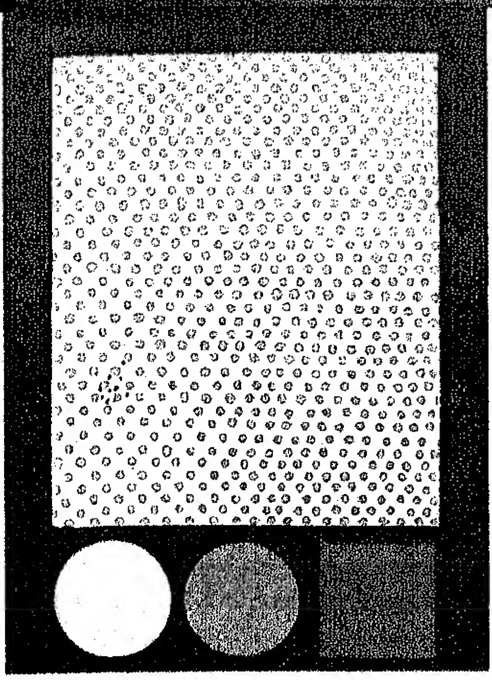


Figure 9.21. Mixing colored lights. Mixing two colored lights results in an intermediate hue, while a properly adjusted mixture of three primary colors of the right intensities gives white light. (Reproduced, with permission, from the Kodak Data Book. *Color as seen and photographed.* Rochester: Eastman Kodak Co., 1950.)

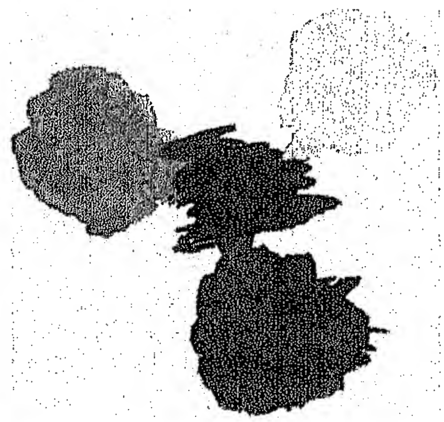
Figure 9.22. Complementary colors. a. *The hues of the visible spectrum arranged on a circle in such a way that complementary colors lie opposite each other. Wavelengths from about 494 to 569 have no spectral complementaries.* (Adapted from Morgan, C. T. *Introduction to psychology.* New York: McGraw-Hill, 1956.) b. *Pairs of complementary colors which combine to produce gray.*

9.22*a*





9.23*a*



9.23*b*

Figure 9.23. a. *Additive and subtractive color mixture. When seen from a distance, the yellow and blue dots combine in additive mixture to produce gray. When the same yellow and blue pigments are mixed, the result is a subtractive mixture, the green shown in the figure.* b. *Subtractive mixture of three primary colors. When red, green, and blue pigments are mixed, all wavelengths are absorbed and the result is black.*

9.22*b*

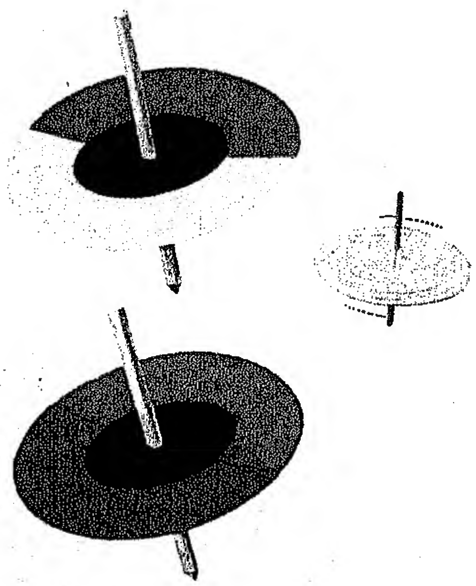
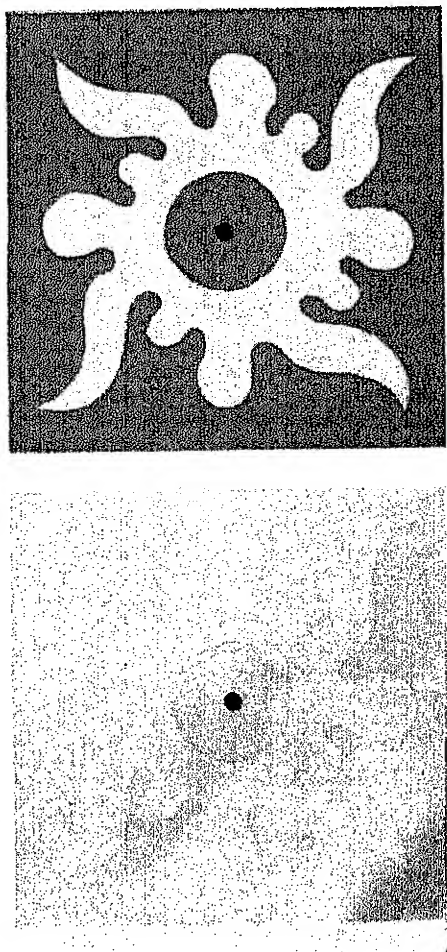


Figure 9.24. Color induction and contrast. The background colors cause the patterns to appear different in both hue and brightness, although they are cut from the same light green paper. You can see a negative after-image by fixating the dot in the center of either square for about one minute and then looking at a piece of white paper.



demonstrate what this means by using the color circle in Figure 9.22*a*, which represents the visible spectrum with the red and violet ends joined by a nonspectral purple inserted between them. The hues on the circle are arranged so that complementary hues lie directly opposite each other. The tops in Figure 9.22*b* show pairs of complementary colors which produce gray when the tops are spun.

According to the third law of color mixture, the mixture of any two noncomplementary hues in the spectrum will produce a third hue intermediate between the two. Thus in Figure 9.21 we see that mixing red and green lights produces an intermediate yellow, mixing green and blue produces blue-green, and mixing blue and red produces nonspectral purple.

Perhaps you have been wondering why the laws for mixing lights do not correspond with the rules followed for mixing paints or pigments. For example, we have said that mixing red and green lights produces an intermediate hue—yellow—although we know that mixing red and green paints gives a dirty brown. Mixing lights is an additive process, in which the energy of each light is added to the other light or lights in the mixture. An ordinary colored light is not a single wavelength, but a band of wavelengths which we perceive as being of the hue corresponding to the dominant wavelength. Thus when we mix two lights, we are really combining two bands of wavelengths, and the perceived effect depends on the relative distribution of energy in the mixture. Two bands of wavelengths perceived as red and green when combined are perceived as an intermediate yellow.

When we mix paints we combine chemical substances which absorb and reflect light selectively. A red paint absorbs most of the wavelengths of the spectrum except a restricted band of long wavelengths seen as red. In the same way, a green paint reflects only a restricted band of wavelengths seen as green. Now if we combine these two paints, the resulting mixture absorbs almost all of the wavelengths, resulting in a perceived hue of low intensity and low saturation—a dirty brown. This is called a subtractive color mixture, since we subtract more and more wavelengths from the reflected stimulus band.

To demonstrate the essential difference between light mixture and pigment mixture, view the pattern in Figure 9.23*a* at a distance of about ten to fifteen feet in good light. The light from the complementary yellow and blue dots will combine to some extent to produce a gray effect. The green in the figure was produced by combining the same yellow and blue pigments. Figure 9.23*b* represents the results of combining three primary pigments—red, green, and blue. When all three are mixed, the result is not white—as when three primary lights were mixed in Figure 9.21—but black. When the pigments are combined, all wavelengths are absorbed and the result is black.

Color Induction and Contrast. The richness of color in the visual field is due not only to the direct action of light on the retina, but to effects produced by the visual system itself. For example, the yellow sometimes seen in small, wispy clouds against the deep blue sky after a storm are induced chromas. So, too, are the greens seen in thin cloud layers against the red of the sunset. The bright halos seen against dark objects fixated for some time are effects produced by the eye itself and do not exist in the stimulus pattern.

One type of color induction is called *simultaneous color contrast.* Look at the two patterns in Figure 9.24, one on a yellow and one on a blue background. Do the silhouettes appear to be the same color? Actually they are, as we can see if we examine them through a small hole punched in a card. The color of the background causes contrast effects in both hue and brightness. The light green figure appears gray on a yellow background, and quite green on a blue ground.

Simultaneous color contrasts are spatial effects, but we also can demonstrate induction effects in time. Almost everyone has noticed the persisting image of an electric lamp after it has been turned off. This immediate image, of the same color as the light, is a *positive after-image.* After a moment the positive after-image is replaced by a *negative after-image,* which is opposite in color. The two images of the light may alternate several times. The chromatic relationships in negative after-images can be demonstrated by fixating the dot in one of the patterns in Figure 9.24 for about one minute and then looking at a white piece of paper. Our negative after-image reproduces the pattern, but appears in colors *complementary* to those in the figure. After-images tend to be quite fuzzy and indistinct compared to the original stimulus pattern.

Both color contrast effects and negative after-images follow the principles of color mixture and are based primarily upon a process of selective visual adaptation. When the retina is stimulated by one hue, it loses some sensitivity to that particular hue, while the relative sensitivity to the complementary hue is enhanced.

Chromatic effects can be induced in space and time by means of achromatic patterns. Look at the pattern of black and white lines in Figure 9.25 in a fairly bright light for several minutes. You will soon see scintillating chromatic effects appearing in the pattern. Somewhat similar induced color effects in which purples predominate can be obtained by looking at a light which is interrupted two or three times per second.

Color Appearance. Colors not only interact with one another but also with the form and space characteristics of a visual pattern to induce *object qualities* or object colors.[6] Several object qualities which can be seen in the color photographs in Figures 9.13 and 9.26 are luster, hardness, warmth, transparency, and glossiness. These effects are not physical aspects of light itself. They are found only when color patterns are seen in relation to objects of certain texture, form, depth, size, and distance. They are induced characteristics of the color and space properties of objects.

Still another induced aspect of color is *mode of appearance,* or the way colors are observed in relation to the nature and source of the light. We can identify four modes of appearance: glow, surface, volume, and film (Fig. 9.26). The glow of colors is seen in objects which emit light. Surface color is the most common mode of appearance in our color perceptions. Here, color is seen as belonging to an opaque surface. Film colors are seen as having no specific surface or locus in space, and no apparent texture. An apparent volume is seen in colors when light passes through the bulk of a more or less uniform and transparent substance.

The mode of appearance and object quality of colors are as important in our color perceptions as hue, saturation, and brightness. The appearance of a colored

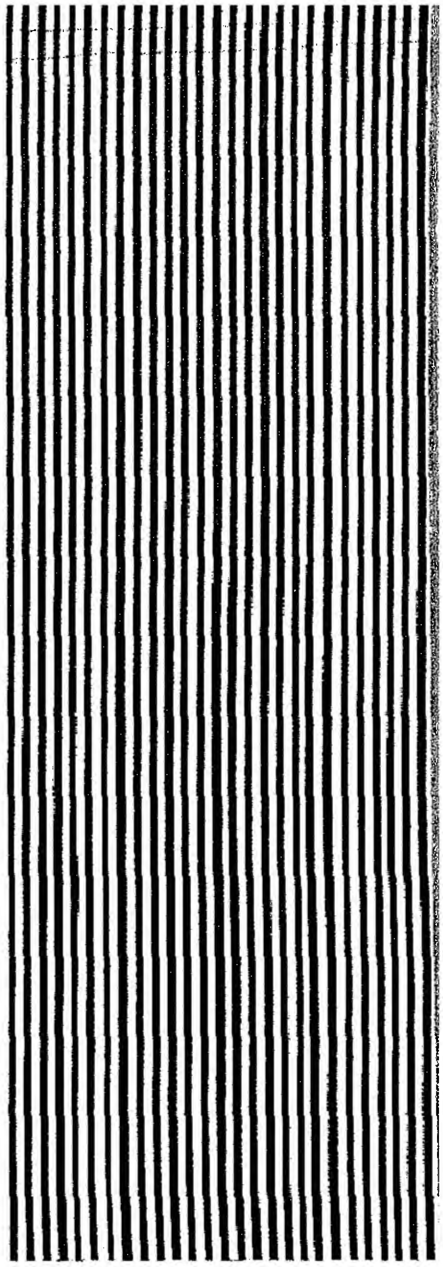
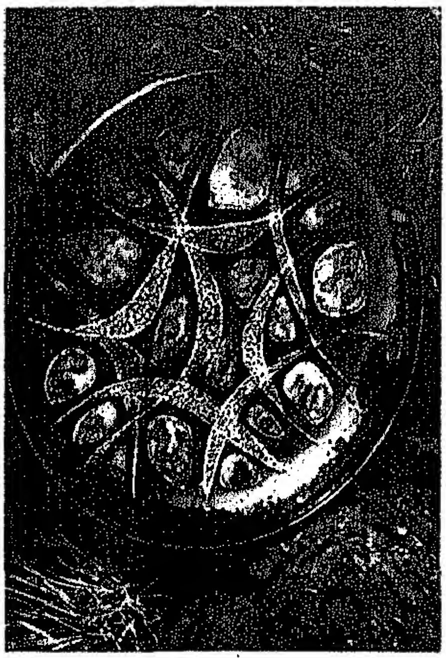


Figure 9.25. Chromatic effects induced by achromatic patterns. Look at this pattern of lines in a bright light for several minutes. Do you see scintillating chromatic effects appearing in the pattern? Induced colors are produced by effects within the visual system.



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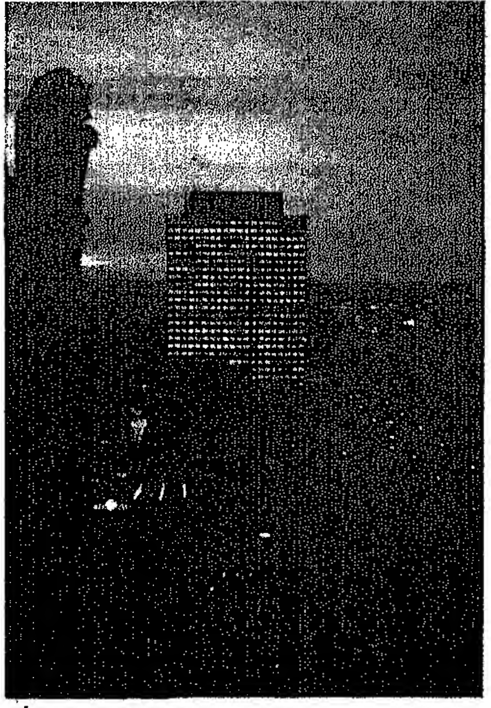

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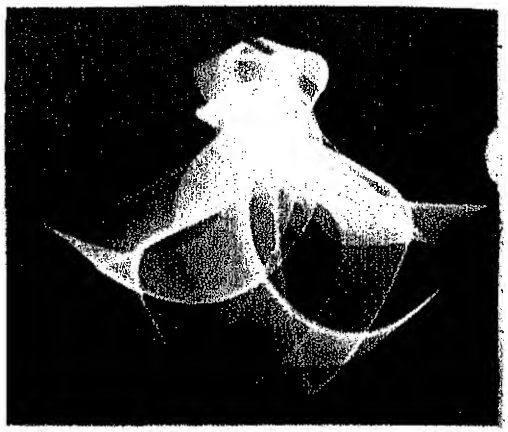
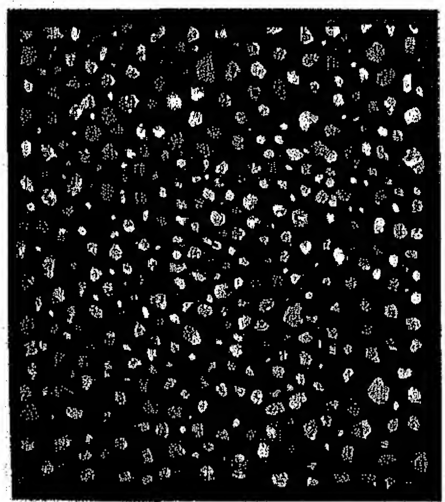


c

Figure 9.26. Object colors and modes of appearance. When patterns of light are seen in relation to objects, they take on induced object qualities, such as glossiness and hardness seen in the ceramic plate on the left. Colors observed in relation to the source of light may appear as glow, as in the center picture, or as film color, in the oscillon on the right. (Courtesy Toshiko Takaezu, Dr. Van R. Potter, and Ben F. Laposky.)

Figure 9.27. Color blindness test patterns. The patterns in a *and* b *can be used to demonstrate the relative insensitivity of the normal fovea to blue light (see text).* c. *A confusion pattern from a standard test for color blindness. Persons who confuse reds and greens see a different number in this pattern than those with normal vision.* (From Amer. Optical Co. Pseudoisochromatic Plates—Beck Engraving Co.)

a



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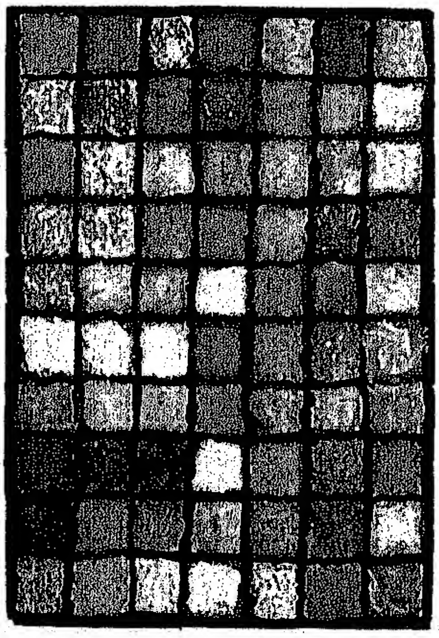

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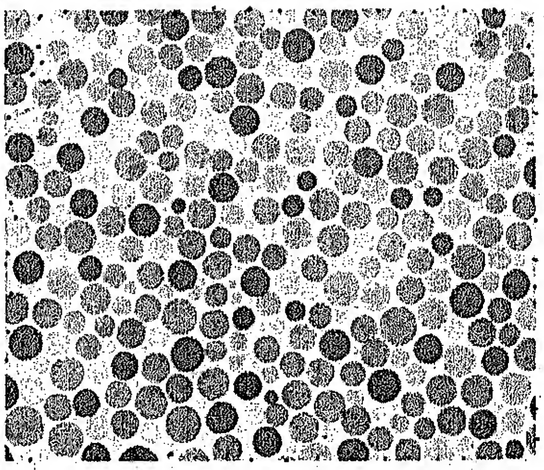


photograph differs from the real situation both in the basic dimensions of color and in the integrated perceptions of color and form. Experts in handling color displays must understand all aspects of vision—stimulation, figure-ground formation, space quality, induced color effects, object quality, and mode of appearance.

Color Blindness. Defects of chromatic sensitivity show up both in the normal eye and in abnormal vision. We have already learned that different hues are not seen in the periphery of vision because only rods and no cones are found near the outer circumference of the retina. There is a small area in the center of vision—not the blind spot—which is also partially color-blind. Look at the green and blue colored patch in Figure 9.27*a*. If a number can be seen in this pattern, look at it again from a distance of about 15 feet. The disappearance of the number at this distance is a result of a relative insensitivity for blue light at the fovea. The same weakness can be demonstrated in a different way by Figure 9.27*b*. Close up, one sees no pattern in these patches, but at a distance of 10 to 15 feet the number 1 stands out clearly. When the pattern is close enough to the eye to stimulate a relatively large area, the blue patches are perceived and disrupt the pattern of the green numeral. When the size of the retinal image is reduced so that it falls at the center of the fovea, the blue colors cannot be seen clearly and the number 1 stands out.

This form of normal "color blindness" at the fovea has been called foveal tritanopia. Those occasional individuals who show the same inability to see blue light throughout the retina are said to have *tritanopia*, or a weakness in seeing the third primary color. True tritanopes also do not see yellow normally.

The defect known as color blindness varies from *achromatism* or total color blindness, in which only brightness and no hues can be discriminated, to color weakness or *anomalous trichromatism*. Normal vision is trichromatic, meaning that all hues can be matched by mixing three primary colors. Color-weak trichromats still use three primaries to match all their perceived colors, but the ordinary color-blind individual is *dichromatic*, matching all colors with mixtures of two primaries. Besides the very rare tritanopes described above, there are *protanopes* and *deuteranopes*, who confuse reds and greens. The visible spectrum is cut short at the red end for protanopes. Color-weak individuals perceive all hues, but do not match colors in a normal way. They may need more red, green, or blue in mixing colors than the normal individual.

Tests for color blindness are usually based on confusion patterns such as those we looked at in Figures 9.27*a* and *b*. The pattern in Figure 9.27*c* is an example of those used to identify persons who confuse reds and greens. Persons with normal vision perceive a different number in this pattern than do those who are color blind or color weak. About 6 percent of all men confuse reds and greens, but fewer than 1 percent of women. This is because most color blindness is genetically transmitted as a sex-linked recessive characteristic (see page 122).

Color-vision Theory. With all of the detailed information which has been collected about the perception of color, we still do not know exactly how many kinds of visual receptors underlie our perceptions or how they work. We have said that the retina

contains rods and cones, and that rods function only for achromatic vision while cones are responsible for chromatic vision. This division of labor is sometimes questioned but is generally accepted as describing the facts. The real problem is to explain the processes of chromatic vision.

One of the most useful theories of color vision in describing known facts was formulated over 150 years ago by Young and elaborated later by Helmholtz and others. Known as the Young-Helmholtz theory, it attempts to explain what is often considered the central fact of chromatic vision—namely, that all of the various colors perceived can be matched by the proper mixture of three primary hues. This theory accounts for trichromatism by postulating the existence of three types of chromatic receptors, or cones, one type most sensitive in the red region of the spectrum, another in the green, and the third in the blue. The perception of any particular hue would be the result of the combined action of the three types of cones.

The Young-Helmholtz theory gives a satisfactory account of the facts of color mixture as we have discussed them above. The perception of white is supposed to result from equal stimulation of the three types of cones, and the perception of yellow from stimulation of "red" and "green" cones. Any hue other than the three primaries would result from an integrative effect at some stage in the neural response.

The perception of yellow presents real difficulties to the trichromatic theory. If yellow is not a "retinal color" but an integrated "brain color," it should be perceived readily from a fusion of green stimulation in one eye and red stimulation in the other. As a matter of fact, this binocular fusion has been demonstrated, but with some difficulty. Another problem concerns the color zones of the retina. We saw in Figure 9.17 that the zones for yellow and blue are larger than those for red and green. In other words, there are certain areas of the retina where yellow can be perceived but red and green can not. If perceived yellow is due to effects from red and green receptors, how can we account for the relative size of the color zones?

Another problem which has never been adequately treated in the Young-Helmholtz theory is the receptor basis of the various kinds of color blindness. Dichromatism has been explained in the three-receptor theory as due to a defect in the red receptors or the green receptors, or both. However, the perception of yellow may be undisturbed in dichromats. If there is a red-green defect, how can yellow be accounted for in a three-receptor theory?

An attempt to modify the Young-Helmholtz theory to make it fit the facts of color blindness and retinal color zones was made by Ladd-Franklin, who proposed an evolutionary view of color vision. This theory supposes that the most primitive kind of vision discriminates only brightness—that is, white, gray, and black. From the primitive visual substance evolved two other distinct kinds, sensitive to yellow and blue. The third evolutionary step involved the differentiation of red and green substances out of the more primitive yellow. The areas of the retina, then, are most highly developed at the center, where all hues are perceived. Farther out is the intermediate area of development where yellow and blue are perceived. Finally, at the periphery of the retina is found only the most primitive kind of visual substance for achromatic vision. The types of color blindness can be accounted for by the

Ladd-Franklin theory more easily than by Young-Helmholtz.

The evolutionary theory of Ladd-Franklin is essentially a four-component theory of color, and while it has never been as popular as the three-receptor theory, it cannot be discounted completely. As we said above in the section on the color zones, recent physiological evidence indicates that there may be as many as seven distinct types of color receptors. We may yet see a drastic revision in our views of color perception, both in respect to retinal processes and to neural integration of sensory information.

SUMMARY

The three stages involved in attention are preparatory action, orientation, and perceptual observation. The stimulus factors that attract momentary attention relate to the size, position, movement, contrast, intensity, form, color, duration, and repetition of stimulus patterns. Attentional activity is also influenced by individual factors such as preparatory set, learning and experience, and motives and emotions.

The effects of distracting stimuli depend in part on the attitude and motivation of the individual. We are likely to give sustained attention to those events that correlate with our patterns of motivation.

To attract attention, advertising and informational displays should have perceptual immediacy, perceptual distinctness, expectancy value, and perceptual motivation. To hold attention, displays should create positive orientation, should be varied, and should be meaningful to the individual.

Perceptual activities typically organize figure-ground relationships from patterns of physical energy. Perception is an active process, noted for "filling in the gaps."

Figure-ground formation is influenced by certain stimulus factors, such as relative intensity of stimuli, organizational processes within the individual, and learning and motivation.

Perception of three-dimensional space is facilitated by a number of monocular factors as well as binocular disparity—the seeing of disparate images by the two eyes. Depth perception also depends on kinesthetic, cutaneous, and auditory stimulation.

Under certain conditions of stimulation we perceive movement of environmental stimuli which is apparent, not real. The underlying perceptual processes are not greatly different from those which inform us of real movement.

Amidst constantly changing patterns of physical stimuli, the individual perceives a world of constant objects. Perceptual constancy is not absolute but represents a compromise between the properties of stimulation and the stability of environmental objects. Learning is highly important in constancy effects.

We see two kinds of colors: achromatic and chromatic. The region of the spectrum to which the eye is most sensitive shifts from the greenish-yellow region in high illumination to the green region in low illumination. The retina is not sensitive to chromatic colors at its periphery.

Colors vary in hue, saturation, and brightness. Three primary colors can be mixed in various combinations to match any perceived color. Complementary colors, when mixed, produce gray, and two noncomplementary colors, when mixed, produce an intermediate color.

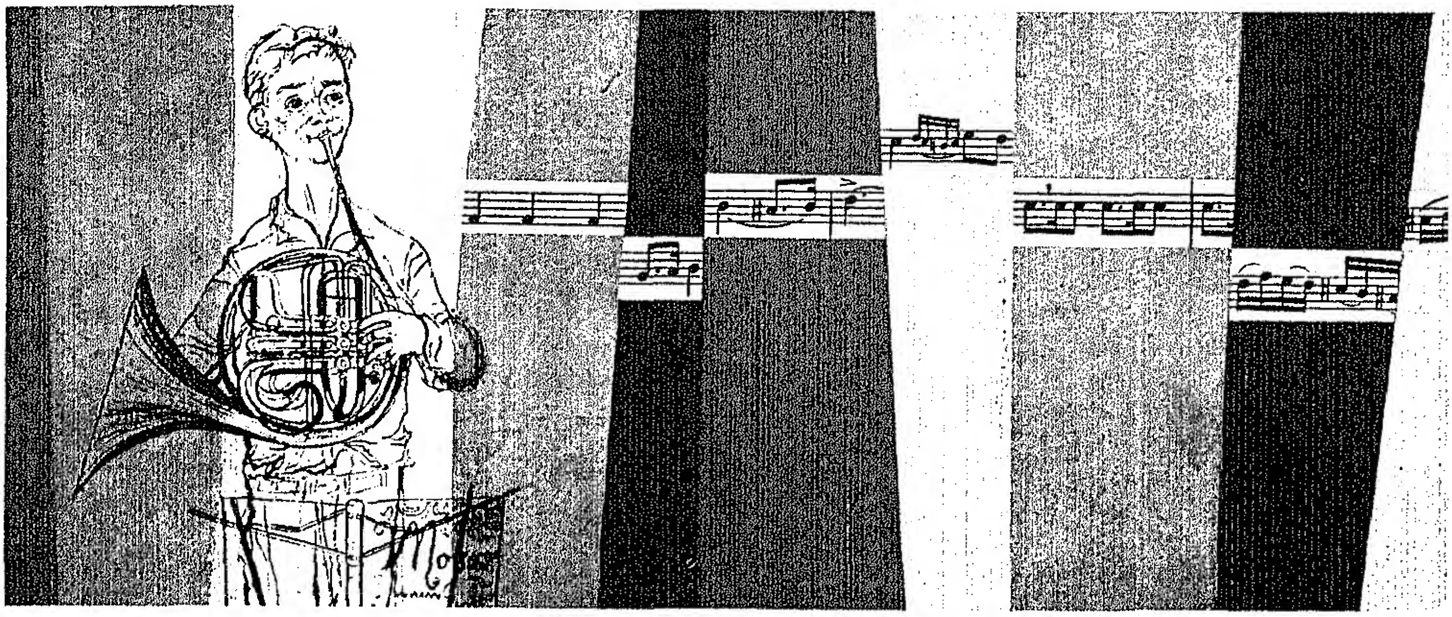
Induced color effects are due to simultaneous color contrast and after-image

effects. Color induction follows the principles of color mixture and is based on selective adaptation of visual receptors.

Colors interact with form and space characteristics to induce object colors and *modes of appearance of colors.*

Most color blindness involves dichromatism, or visual perception based on two primary colors. Color-weak individuals perceive all hues, but not in the same relative brightnesses as normal individuals.

The trichromatic theory of color vision postulates three kinds of cones, each kind most sensitive to one of the primary colors. *This theory accounts for the facts of color* mixture, but does not satisfactorily explain the perception of yellow, the color zones of the retina, or the facts of color blindness.

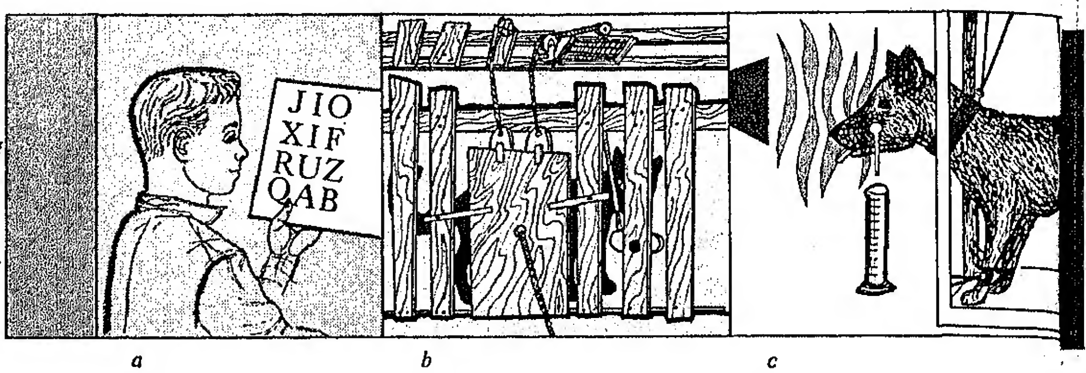


CHAPTER 10. LEARNING: ITS GENERAL NATURE

If they are to survive, both man and lower animals must adapt to the continual changes that go on throughout their lives. One of the forms of adaptation is learning, the acquisition of reactions and patterns of behavior which evolve in relation to change in stimulation. It is not a process that offers us a choice. Learning occurs whether we like it or not, whether we are taught or untaught. The question usually is not "Shall we learn?" but "Where and how do we learn?"

As the civilization of man has developed, the child of each new generation has had to learn more and more. In the relatively nonsocial existence of early man, the necessary habits and skills were quite limited. Growth of social behavior meant that each child had to learn something of group cooperation and use of tools. With the rise of communities and written language, still more complex patterns of verbal and interpersonal behavior developed. Finally, as the age of the machine and of science evolved, the number of habits, forms of knowledge, and skills which could be learned multiplied beyond the limits of any single man. In our modern world, learning is fundamental to all of our behavior patterns—building social habits, acquiring skill, controlling emotion, guiding motivation, achieving a vocation and securing livelihood, fulfilling family responsibility, increasing knowledge, carrying on human relations, and solving creatively the untold number of common and uncommon prob-

Figure 10.1. Great experiments in learning. a. Ebbinghaus launched the laboratory study of learning by using nonsense syllables. Such verbal material is relatively independent of previous learning, and can be equated in terms of difficulty. b. Thorndike's experiments with animals in puzzle boxes led to descriptions of trial and error learning and the formulation of the law of effect. c. The conditioned salivary response, as discovered by Pavlov.



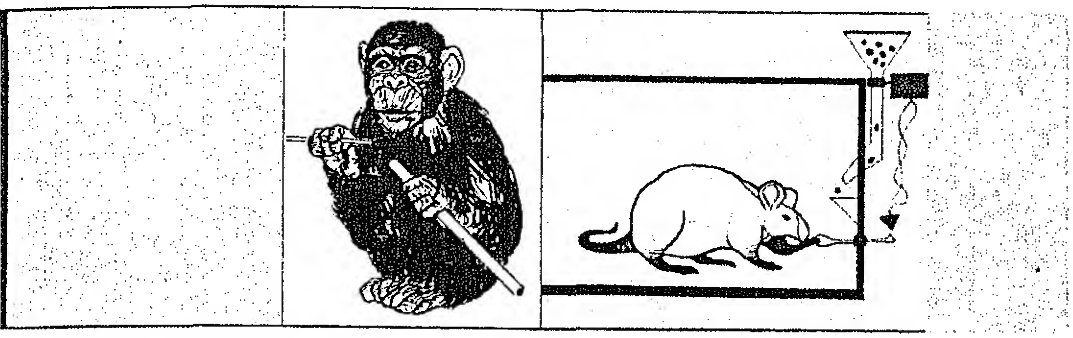
lems met during the course of daily adjustment. Learning is the price of human socialization.

Great Experiments in Learning. The experimental study of learning was one of the first concerns of the newly established science of psychology. During the past seventy-five years, investigations in the field of learning have been of primary importance in channeling psychological research as well as in defining psychological theory. This intense interest in learning is nothing new in Western thought. Since the time of Aristotle, speculations about the acquisition of knowledge have been the core of philosophy. The scientific study of learning has refined the language of such thinking and extended it to the problems of acquisition of all forms of behavior.

The experimental study of learning in psychology goes back to the work of Ebbinghaus in Germany and William James in America. Going a step past philosophical speculation about the association of ideas, these men carried out controlled investigations of verbal learning. James was interested in whether or not learning is a general "faculty" which can be improved by specific learning tasks.[1] Acting as his own subject, he showed by memorizing poems that learning is relatively specific to the material committed to memory. Unless there are common elements in the tasks, one type of learning does not improve learning in a second task.

The highlights of laboratory studies of learning are shown in Figure 10.1. The nonsense syllable, one of the first tools of such study, was invented by Ebbinghaus for the investigation of learning and memory (*a*).[2] In order to study the effects of different conditions—that is, experimental variables—in learning, it is desirable to have units of equal difficulty to be learned so that different conditions can be compared. If subjects are asked to learn verbal material, the familiarity of the material and its motivational aspects cannot be held constant unless nonsense materials are chosen. Also acting as his own subject, Ebbinghaus carried out lengthy studies of the course of learning and forgetting, and of efficiency in learning, by the use of nonsense syllables.

The use of animal subjects in learning experiments gave impetus to a whole new field of psychological research. In this country Thorndike started working just before the turn of the century with cats and dogs in puzzle boxes (Fig. 10.1*b*).[3] Closed inside a box with food on the out-



d e

Figure 10.1 (cont.). Great experiments in learning. d. *Gestalt theory of learning was given impetus by Köhler's experiments on learning in chimpanzees. He emphasized the role of insight in problem solving and learning.* e. *Skinner developed a method of studying learning wherein the subject's responses are instrumental in obtaining measurable amounts of reinforcement. This is known as instrumental or operant learning, in the sense that the individual operates upon his environment.*

side, the animal's problem was to learn to pull a string, press a lever, or make the response that would allow it to escape from the box. In such situations, animals displayed a good bit of random activity before learning the appropriate response—behavior which Thorndike described as "trial and error" learning. In his work with animals and later work in educational psychology with human subjects, Thorndike emphasized the Law of Effect, stating that reactions followed by satisfying results are selected by the individual, while reactions followed by annoying results are avoided or eliminated.

A critical turning point in the scientific study of learning came with the demonstration that overt behavior patterns, including vital reflexes of the organism, can be altered by controlled arrangements of stimuli. The first experiments on the conditioned response, carried out by Pavlov, represent one of the major scientific discoveries of modern times.[4] The diagram in Figure 10.1*c* shows Pavlov's basic finding—namely, that the salivary gland in the dog can be conditioned to secrete when a light stimulus is turned on. The dog was prepared in such a way that the amount of secretion of one of its salivary glands could be measured. In a series of training trials the light stimulus was first presented and shortly thereafter a pan of food was given the animal to eat, causing it to salivate. After several repetitions of the conditioned (light) and unconditioned (food) stimuli in the training trials, the dog salivated when the light was presented alone. The contiguous presentation of the conditioned and unconditioned stimuli had altered the behavior of the animal. This procedure for producing learning is now known as "classical conditioning."

Before Pavlov most psychologists had dealt with learning as a mental phenomenon, in terms of the acquisition of knowledge or the association of ideas. With the discovery of the conditioned response, learning was more widely recognized as a physiological process subject to a certain amount of prediction and control.

On the basis of his experimental work Pavlov developed a comprehensive theory of human and animal behavior. Many other psychologists have followed his lead in attempting to account for all kinds of learning—in fact, all aspects of behavior—in terms of conditioning principles. The gestalt psychologists, in particular, took exception to this point of view. Köhler's work on chimpanzees showed the importance of perceptual organization and "in-

Figure 10.2. The arithmetic machine. Devices such as this incorporate the principle of the Skinner box—correct responses lead to the reward, in this case a new problem presented by the machine. The child knows "where he stands" at all times. (Courtesy Dr. N. Azrin and Dr. B. F. Skinner.)

sight" in problem solving.[5] An example of one of the problems studied by Köhler—the ability of the chimpanzee to put two sticks together in order to reach for food—is represented in Figure 10.1*d*.

More recently, the strict conditioning description of learning has been widely rejected in favor of what is called *operant* learning. This term implies that the individual is operating on his environment. Most of our everyday learning—how to prepare food, build fires, dress ourselves, and so on—can be described as operant. The main interest here is in the response—in what the individual is doing. Operant learning has been called "active" learning in contrast to "passive" conditioning.

Precise methods of studying how rewards and reinforcements affect the learning process in operant behavior were developed by Skinner.[6] The rat in Figure 10.1*e* is shown pressing a bar in order to get one pellet of food for every 100 presses. The pellet is shown falling down the chute leading to the food cup. Similar methods of controlling the nature and amount of reward or reinforcement have been adapted for use in the analysis of human learning. The device shown in Figure 10.2 is an arithmetic teaching machine based on Skinner's procedures.

STAGES IN LEARNING

In most instances of learning three phases can be distinguished: (1) the motivational phase, (2) trial and error or variability phase, and (3) the selection phase. In rapid conditioning or other types of rapid learning, these stages cannot always be seen as separate and distinct.

Some of the main behavioral features of the different stages of learning are shown in Figure 10.3. The child is learning to reach the crackers on a shelf and the rat is learning to pull down a food hopper by means of a beaded string. The figure shows the progress of the child and of the rat from the stage when they are motivated by hunger to seek food to the final stage where both are skilled in carrying out their learned performance.

Our study of motivation has already told us something of the first stage of learning. A motive such as hunger causes the learner to move about, to maintain activity. Thus motivation both sustains behavior as learning progresses and directs it toward an incentive or goal. However, the motivation underlying learning is rarely a single specific drive state. Especially in man, learning is directed and sustained by many types of general and learned motives. The child who climbs to the cracker shelf gets some satisfaction just from climbing and exploring. Other habits related to hunger, such as learning to eat with a spoon and a fork, may be primarily motivated by social pressure from the mother.

The sustained motivation of the organism leads to trial and error, or variable activity. The child and the rat make various responses oriented toward food-getting. Some responses will be completely unsuccessful and some partially successful. The rat hauling on the line may get the hopper close enough to smell or taste the food only to have it slip from its grasp. In time, the critical effects of obtaining the incentive lead to a shift in the nature and amount of the variable activity. As learning progresses, variability decreases.

The selection phase becomes clear when the child and rat begin to show some consistency in repeating the critical reactions which lead to the goal of obtaining food. The behavior gets ever more precise and minor errors are eliminated. The emotional disturbance of the first phases is no longer evident. The learned response is smoothed out and stabilized.

The amount of time spent in trial and error and subsequent selection of a successful response pattern may vary greatly from one learning situation to the other. The rat in Figure 10.3 may learn very gradually over a number of trial periods to pull down the hopper. The child, however, may learn his successful response in one trial. Once he has discovered how to use the stool to climb up to the crackers, he is not likely to forget it. Sometimes we call rapid learning of this sort insight. Insightful learning is more likely to occur when the basic skills necessary for a successful response have already been learned by the individual. The child in Figure 10.3 has had experience with cracker boxes. He has also had experience in climbing on various pieces of furniture. Thus, since a successful response can be established with little or no practice, the period of trial and error

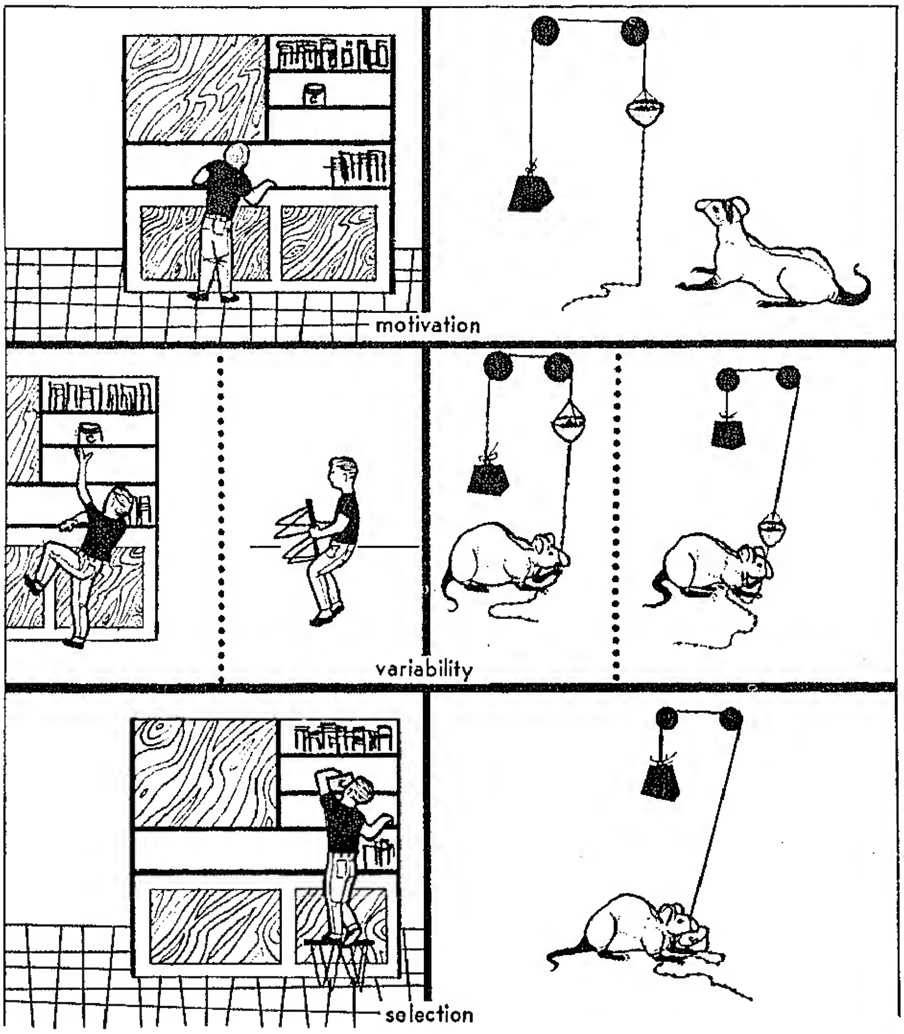


Figure 10.3. Stages of learning in a child and a rat. The first stage, that of motivation, sustains behavior during the trial and error or variability stage. Variability decreases as the correct response is selected, or learned. The amount of time spent in these stages varies greatly.

which he goes through is cut to a minimum.

The selection of a learned response involves the effects of reinforcement (reward and punishment) on the variable behavior of the trial and error period. The responses that lead to the food goal—to the satisfying of the hunger need—are those that eventually are selected in the situation. This effect of *reinforcement* has been given many names in psychology. Thorndike's Law of Effect expressed the concept in terms of "stamping in" the correct response. Regardless of what we call it, the process of selecting specific responses from a wide variety and establishing them as lasting forms of behavior is of critical importance in the scientific study of learning.

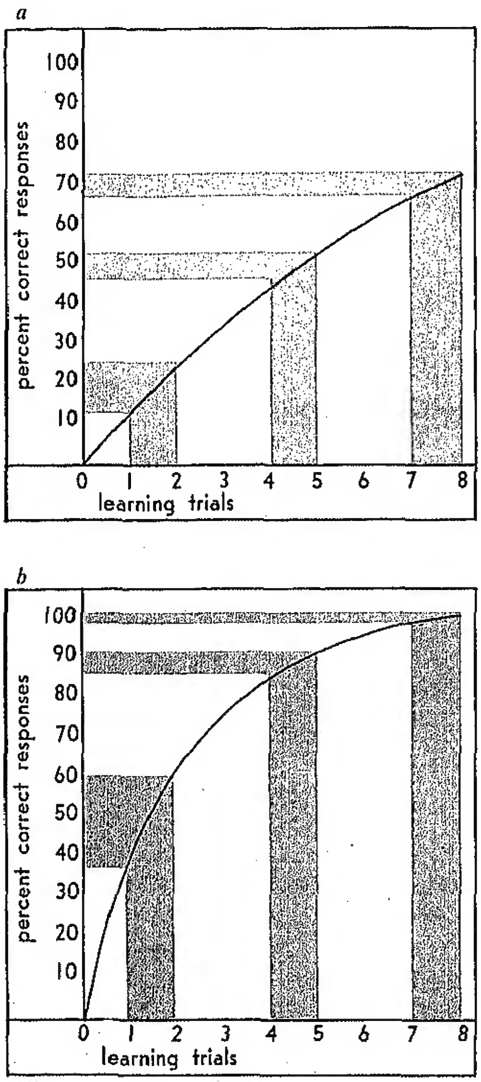


Figure 10.4. Curves for slow and fast learning. The learning process can be represented by plotting correct responses against time or trials. In slow learning, a, *the curve rises more slowly than in fast learning,* b. *A learning curve is typically negatively accelerated; i.e., the increment of learning becomes smaller and smaller with each successive trial.*

The nature of the learned response reflects the complex pattern of motives and emotions which underlie the individual's behavior. Not every child learns to climb for the crackers. One may learn to cry until someone hands down the box. Another may learn to wait until snack time. A hungry baby left alone with a dish of food and a spoon might never learn to use the spoon. Only by observing the behavior of others and by yielding to social training does he come to select socially desirable feeding habits.

The selected pattern of reaction is sometimes undesirable from the point of view of society and may prevent socially acceptable forms of adjustment in some life situations. Emotional habits such as negativism and isolation, and such substitute responses as repression and drug addiction, may develop in a learning situation. In all cases, however, the stages of motivation, variability, and selection describe the orderly process of acquiring the countless forms of learned behavior.

EFFICIENCY IN LEARNING

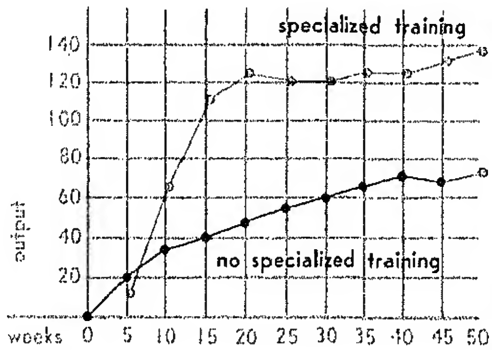
Learning can proceed at a very slow or at a very fast rate. A lot can be learned in a given period of time, or a little. Many different conditions in the learning situation and many characteristics of the learner

define both the rate and the amount of learning.

Learning Curves. Measurements of the efficiency of learning can be made in several different ways. The time required to perform a task and the number of trials needed to learn a task are two measures of learning. The number of errors or correct responses made are two additional measures. If errors or correct responses are plotted graphically against units of time or successive trials, we get curves which can be used to represent rate of learning or rate of forgetting.

Examples of slow and fast learning are shown by the two curves in Figure 10.4, based on the percentage of correct responses in successive learning trials. The shape of the curves represents a typical effect in the rate of learning. The fact that the curves rise fast and then proceed at a slower rate means that learning is rapid at first and then slows down. In slow learning the curve rises very slowly and levels off after a long time (*a*). In fast learning the curve rises and levels off rapidly (*b*).

A comparison of actual slow and fast learning curves extending over a period of almost a year is shown in Figure 10.5. These curves are based on production of two groups of workers in a factory situation illustrated by the accompanying photograph. The differences in the two curves were based on differences in training procedures. The fast group was given specialized training guided by understanding of methods in machine operation, while the slow group received the usual training by supervisors in the factory. Notice that the curve of the slow group rises at a slow rate and does not reach the top level attained by the group given specialized training.



a

b

Figure 10.5. Effect of special training on learning. The curves show the rate of learning a hosiery operation as measured by production output over a long period of time. Specialized training resulted in more rapid learning. (Adapted from Seymour, W. D. The economics of specialized operative training. *The Manager*, Nov., 1951; photograph courtesy the Berkshire Knitting Mills.)

The curve for the fast group rises rapidly for about eight weeks and then continues upward at a much slower rate for about thirty weeks.

The relatively level stretch in the fast curve from the twentieth to the fortieth week is called a *plateau.* Plateaus in learning curves are periods of no progress followed by subsequent improvement. A secondary increase in learning rate may be caused by reorganization of the method of attack on the learned task or changed conditions of motivation or both. The introduction of special incentives can probably raise the level of almost any learning curve. Learning has a physiological limit, but rarely, if ever, is this limit achieved under usual conditions of learning.

In studying learning, we must remember that we do not observe the learning process directly, but observe performance. We assume that learning has taken place because of the observable changes in performance. There are times, however, when performance is not an accurate indicator of what the individual knows or can do. For example, we all have experienced performance failures, under conditions such as stage fright, of behavior that has been learned and can be performed at a later

TABLE 3. *Individual Factors in Learning Efficiency*

Factor	*Slow Learning*	*Fast Learning*
1. Age	Very young and very old	Pre-adolescent, maturity
2. Intelligence	Less intelligent	More intelligent
3. Motivation	Too little or too much	"Optimal" motivation
4. Participation	Little participation	Active participation
5. Learning set	Little previous experience with task	Extensive experience with task
6. Intention	No intent to learn	Intent to learn

time. We shall have more to say later about factors that interfere with performance.

Individual Factors in Learning Efficiency. The efficiency of learning is related to a number of different characteristics of the learner. Table 3 indicates some general conclusions that can be drawn from the results of many different experiments. In special cases or in particular individuals, results other than those indicated may be obtained.

Age. In general, individuals learn most rapidly in early maturity. Older and younger people learn less rapidly. However, this generalization does not apply to all types of performances.[7] Older individuals apparently learn some things, such as partly familiar school studies, as well as younger people. The general drop in learning ability among older people very probably can be accounted for in terms of reduced motivation to learn, slower speed of response, and reduced ability to cope with unfamiliar tasks.[8] This last characteristic of learning in the aged has been explained as resulting from the interference of established habits with the demands of novel learning situations.

Intelligence. Highly intelligent people generally learn more and at a faster rate than individuals of average or low intelligence. But here again, the type of performance to be learned is a factor.[9] Efficiency of learning shows a higher correlation with intelligence in verbal and symbolic tasks than in motor performance tasks. We also must remember that intelligence itself is not a unitary thing, but is composed of different kinds of abilities—number ability, spatial ability, verbal ability, and so on (see Chap. 15). If we define intelligence in terms of performance in certain kinds of tasks, it is not surprising to find that more intelligent individuals are the faster learners in these same tasks.

Motivation. Learning is most efficient when motivation is neither too low nor too high. Extreme motivation leads to anxiety and stress in the learning situation. The study of real-life stress in Chapter 7 and other similar studies have shown that anxiety tends to interfere, particularly with verbal learning. Studies which have investigated the effects of feelings of failure and anxiety combined also show that such extreme emotional motivation can interfere with learning.[10] On the other hand, as we saw in Chapter 7, the conditioning of certain reflexes is enhanced rather than depressed by anxiety.

The other determining factors included in Table 3 have been the subject of many experiments. The problem of motivation

TABLE 4. *Situational Factors in Learning Efficiency*

	Factor	*Slow Learning*	*Fast Learning*
1.	Time between response and reward or punishment	Long time	Short time
2.	Pattern of practice	Massed	Distributed
3.	Arrangement of task	Artificial	"Natural"
4.	Meaningfulness of material	Meaningless	Meaningful
5.	Guidance	Too little or too much	Some guidance
6.	Knowledge of results	No knowledge	Knowledge

and amount of active participation in the learning situation have been investigated in relation to learning during sleep. Those who have read Huxley's *Brave New World* will remember that citizens were fitted for specific social roles by means of Pavlovian conditioning during sleep. A rigorously controlled experiment has shown that verbal material presented during sleep is not learned at all.[11] According to the best scientific evidence, devices sold commercially during the past few years for the purpose of presenting material to be learned during sleep have been misrepresented.

Learning in a given situation does not develop any general faculty of learning, but it does create expectations and ability to deal with similar situations in the future. The establishment of expectations which facilitate particular types of learning has been called formation of learning sets.[12] The intent to learn is a form of learning set. These are just other ways of describing the active participation of the individual in the learning situation, and all of these factors might be described as motivational effects. The person who participates actively, who intends to learn—who has a learning set, in other words—learns more efficiently than if he were motivated to carry out some other line of activity.

Another aspect of the participation factor is that of learning by doing, or performing the task to be learned in the same way in which it will be carried out later. A speech is not learned most efficiently by reading and rereading it, but by *speaking* it, preferably in front of someone. This principle of learning is one of the most important of all in the acquisition of knowledge and habits. Its validity has been demonstrated by numerous experiments and it is a maxim of learning with few, if any, exceptions.

Situational Factors in Learning Efficiency. Efficiency of learning is determined not only by characteristics of the learner but by numerous factors or conditions of the learning situation itself. Factors of this kind which have been studied experimentally are shown in Table 4, together with the indication of the more efficient and less efficient conditions.

Time of reward and punishment. The time at which a person or an animal receives a reward or is punished after making a response is a critical factor in learning. In training situations this interval can be of crucial importance, although it is not necessary that reinforcement be given after each correct response. The evidence indicates that the shorter the interval between

the occurrence of a response and reinforcement, the more efficient the learning.[13]

When punishment is used to teach a learner not to make a specific response, the factor of time is particularly important. Punishment, if used at all, should be used immediately after the incorrect response has occurred. Any delay in its application not only reduces the efficiency of learning but produces confusion on the part of the learner. In the learning of reactions of a positive nature, such as learning a skill or learning to read, punishment acts in a complicated and unpredictable way; that is, the punishment can come as a source of emotional response and frustration and hence interfere with learning. We shall learn more of the roles of reward and punishment later in the chapter.

Pattern of practice. Results of many studies have established that distribution of practice and arrangement of the task can be factors of considerable importance in efficiency of learning. Distribution of practice has to do with the "cramming" problem, for one thing. Many students cram for exams for purposes of expediency and also because they think it necessary. Generally speaking, distributing learning over several practice periods is better than spending the same amount of time and effort in one learning session.[14] Also, when material or tasks can be arranged according to some sequence or order, the rule is to avoid artificial arrangements in favor of "natural" ones.

One aspect of the patterning of practice which has been investigated many times is the problem of whole versus part learning; that is, which is more efficient, practicing material all together, or practicing and learning it by parts? It has been found that superiority of one method over the other depends on individual factors as well as on the type of material to be learned. In general, learning is more efficient when *meaningful* wholes are practiced, if the total length is not beyond the individual's grasp. Older persons can handle more material by the whole method than can children. Moreover, an individual becomes more adept at learning wholes after practice in this method.

Information in the learning situation. The last three factors in Table 4 concern the effects of information on efficiency of learning. The meaningfulness of the material or task itself is important, as would be expected. Prose and poetry are learned faster than nonsense syllables or disconnected words. A task made up of unfamiliar elements with little or no meaning to the individual is very difficult to learn. When we learn meaningful material, we are recombining responses that have already been practiced in the past.

Guidance also is important in learning. Early in the task, proper guidance serves to make the task meaningful and to motivate the learner. As learning progresses, guidance provides the means of giving knowledge of correct performance and mistakes. Guidance has its most pronounced effect early in learning. However, too much guidance can often do more harm than good—a fact many parents and teachers do not appreciate.

Knowledge of results is sometimes referred to as the "feedback" factor in learning. It is related to reward and punishment as well as to information about the nature and correctness of performance. Knowledge of results increases the amount of information available to the learner, makes the task more meaningful, and generally serves as a type of reward or reinforcement,

Many of the special problems of teaching, coaching, and the designing of training equipment deal with the important factor of knowledge of results and information in the learning situation. To make the most of this principle of learning, it is clear that the teacher, the instructor, and the coach must know thoroughly the details of what is being taught in order to provide proper and useful information to the learner.

Special training equipment such as the device to teach arithmetic shown in Figure 10.2 points up the significance of the problem of controlling knowledge of results. Similar but more elaborate problems are encountered in the design and development of aircraft, electronic devices, and other industrial and military training devices.

Serial Learning Effects. Efficiency of learning has been investigated in studies of verbal behavior, motor skill, and conditioning. Figure 10.6 illustrates a method of studying the effects of distributed and massed practice in serial learning of verbal material, as well as some experimental results. A memory drum, used to present the verbal material, displays, in a timed sequence, a series of names, words, or nonsense syllables. The name "Poggendorf" is moving into position in the exposure panel of the drum, and the name "Poppelreuter," *which has just been exposed, is* moving out of position.

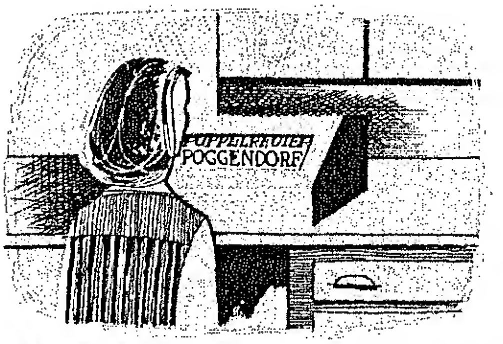
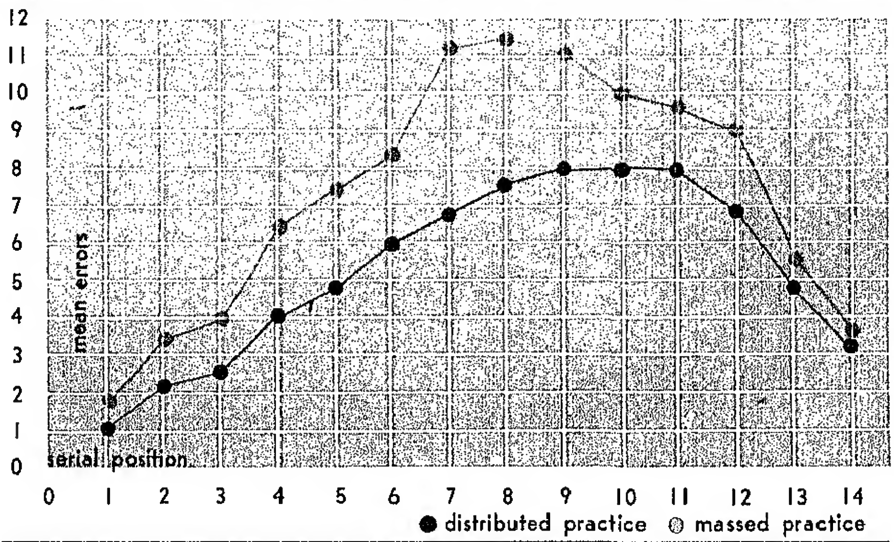


Figure 10.6. Serial learning with massed and distributed practice. Lists of 14 nonsense syllables shown on a memory drum were learned more efficiently by distributed than massed practice, but in each case the syllables at the ends were learned before the ones in the middle. (From Hovland, C. I. Experimental studies in rote-learning theory. VII. Distribution of practice with varying lengths of list. *J. exp. Psychol.*, 1940, **27**, 271–284.)



The graphs in Figure 10.6 show the results of an experiment in which a serial list of fourteen nonsense syllables was learned. One group of subjects learned the list under distributed practice, another under massed practice during a single session of "cramming" of the verbal material. The number of errors made in learning the lists was determined for each group of subjects and for each of the fourteen syllables. The two curves give the differences in performance *for massed and distributed practice in terms* of mean number of errors made at each *serial position;* that is, the mean number of errors made by each group during learning is plotted separately for each of the fourteen syllable positions in the list. The curves show that in massed practice, more errors were made at every position than were made in distributed practice.

The curves in Figure 10.6 also show that

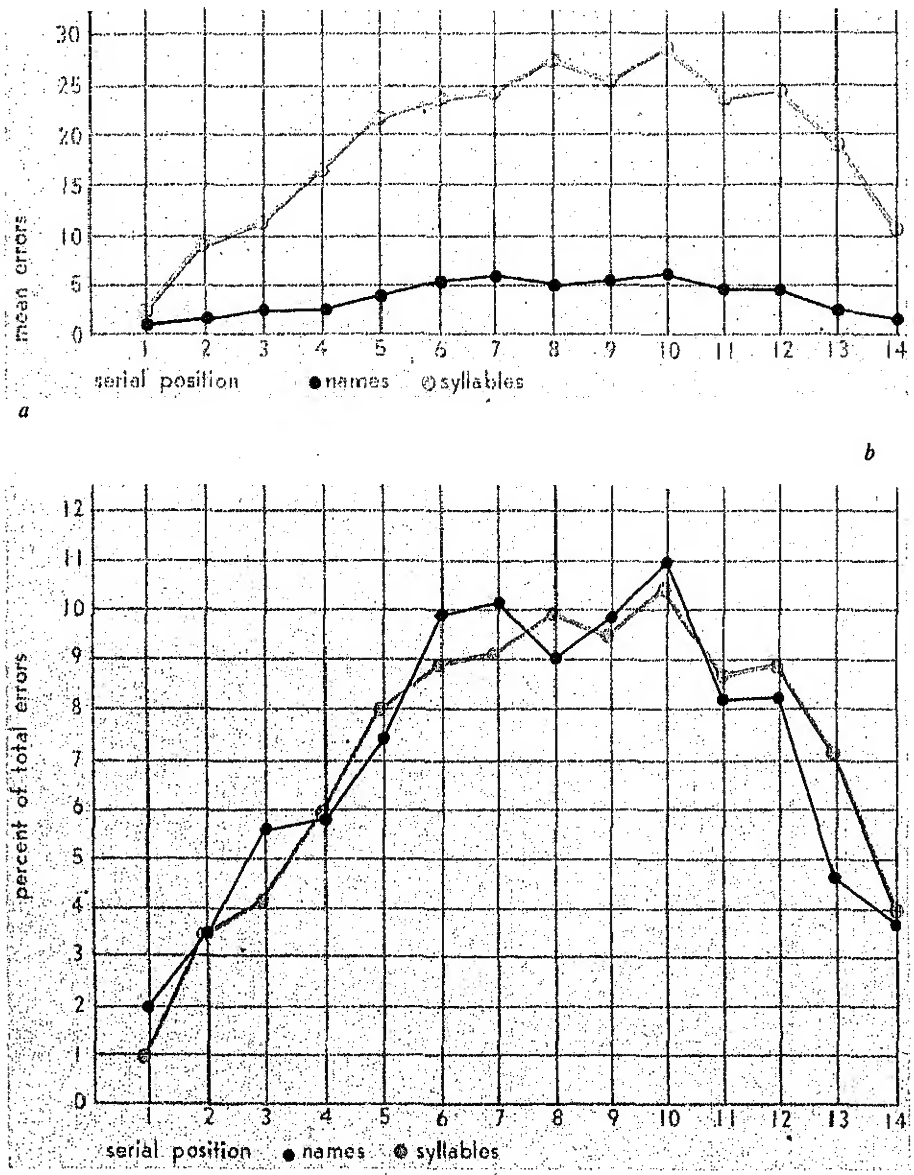


Figure 10.7. Position effect in serial learning. a. *More errors were made in learning lists of nonsense syllables than lists of names.* b. *When errors in each serial position were plotted as percentage of total errors, the curves for the two types of material were almost identical.* (From McCrary, J. W., and Hunter, W. S. Serial position curves in verbal learning. *Science*, 1953, **117**, 131–134.)

during learning more errors were made on syllables in the middle of the list or slightly beyond than were made on the syllables at the beginning and the end. Fewest errors were made at the beginning. This so-called *serial position effect* is found not only in verbal learning but in such other types of serial learning as sequential motor habits and maze learning.

The Hunter-McCrary Law. In Figure 10.6 we saw that the absolute number of errors made at each position in a serial order is *greater for massed than distributed practice.* Distributed practice is more efficient for learning at every position in the series. Other learning factors, such as meaningfulness of material or intelligence of the learner, also affect the *total* number of errors made in serial learning, but the serial position curves still show the same general characteristics; that is, in a serial position curve, the fewest errors occur at the beginning and end and the most occur in the middle and slightly beyond.

The curves in Figure 10.7*a* show the serial position effect in learning meaningful and meaningless material. The top curve shows the mean number of errors in the learning of a list of fourteen nonsense syllables as contrasted to errors in learning fourteen names, shown in the bottom curve. If these same data are handled in a *different way statistically, a very interesting fact* is revealed. When we plot for each serial position the *percentage of total errors* made at that position, instead of the absolute number of errors (as in Fig. 10.7*a*), we find that the *relative* serial position curves are almost identical (Fig. 10.7*b*). Regardless of whether meaningful or meaningless material was learned, about 1 to 2 percent of the total errors occurred at position 1, about 6 percent at position 4, about 10

percent at position 10, and so on. Irrespective of the general conditions of efficiency for a given kind of serial learning, the relative distribution of errors throughout the sequence remains fairly constant. We call this the serial position law, or Hunter-McCrary Law, after the two psychologists who discovered the effect. It has been shown to apply to massed and distributed learning, meaningful and nonsense learning, and the performance of slow and fast learners.

We do not have a completely satisfactory explanation of the serial position effect. When a series of responses is learned, the individual not only learns associations between each unit and all the others in the series, but also learns to associate each unit with its position in the series. Thus the first nonsense syllable in a list would stand out clearly as being in the first position, and the last, in the final position. The positions in the middle of the list would be remembered less easily. In addition to these position associations, each syllable would be associated with all the other syllables, less strongly for the more remote syllables. The syllables at each end would have fewer near associations than those in the middle, and thus *interference* effects at the ends would be weaker.

The concept of interference is an important one in learning. When we are measuring the performance of one learned response, all other possible associations can be considered as interfering factors; that is, the selection of one response requires that all other possible responses be eliminated. Insofar as other responses can be elicited, they constitute an interference to the "correct" response. Later we shall see that the forgetting of one learned response can be thought of as the result of interference of other learned reactions. Learning in the adult always involves interference with or modification of previously established learned responses.

To come back to serial learning, it has been proposed that the changing shape of the serial position curve is due to greater interference among parts of the task in the middle of the series. There are probably other factors which help determine the serial learning effect. Conditions of motivation in particular might be part of the explanation. We are likely to be more highly motivated and "try harder" at the beginning and end of a series.

DYNAMICS OF LEARNING

We have been considering some of the conditions, both within the individual and in the learning situation, that influence the measurable performance of the learner. To understand more fully the nature of the learning process, we need to analyze these conditions in more detail. We would like to know why some conditions make for greater efficiency in learning, and others for less. Why does "learning set" improve efficiency? Why is the time between the response and the reward important? Why does the pattern of practice influence the course of learning?

Although we cannot give a final answer to these questions, we can start by analyzing more carefully the stimulus-response relationships in learning and by trying to understand how learning occurs in the total organization of behavior. Conditioned response learning and operant learning, which we have already described briefly, provide the primary techniques for the analysis of the dynamic aspects of the learning process.

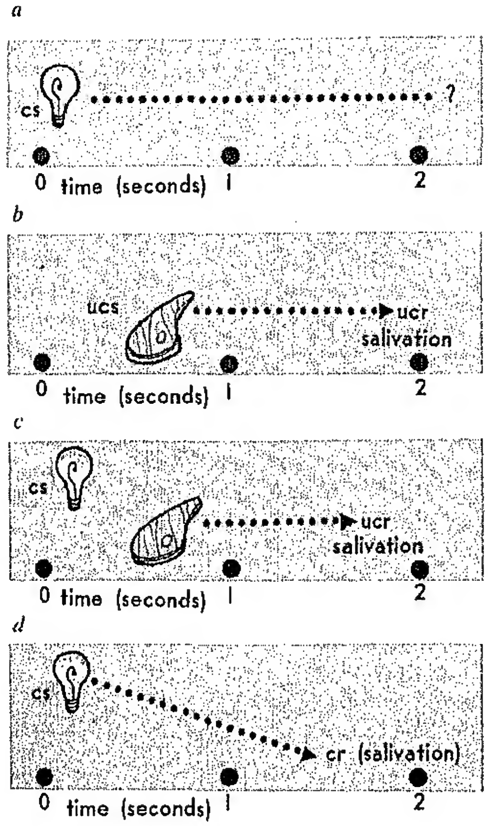


Figure 10.8. The steps in classical conditioning. Before learning takes place, the CS, the light, elicits a variable response, while the UCS, the food, elicits salivation (UCR). After CS and UCS are paired, CS elicits salivation (CR).

There are several stimulus and response factors which are recognized as being primarily responsible for the formation of learned behavior. One of these is the factor of time, the *temporal contiguity* of stimuli and responses involved in learning. Another is the factor of *reinforcement,* the effects of both rewards and punishments. The particular way in which reinforcement occurs is known to be decisive in defining the course of learning. In our study of the dynamic course of learning, we shall consider a number of special characteristics of learned behavior, including generalization, differentiation, inhibition, and extinction.

Temporal Contiguity. The method of the conditioned response has made it possible to study in detail the time factors involved in learning. The conditioned response, as studied by Pavlov and others, puts primary emphasis on the concurrence in time of specific stimuli and responses.

In classical conditioning, a given stimulus acquires the ability to elicit a response which previously it did not elicit. The process of conditioning the salivary response of the dog to light is diagrammed in Figure 10.8. Before learning, the response to the conditioned stimulus (CS), the light, is questionable or variable (*a*). At this same beginning stage, an unconditioned response (UCR) of salivation is made to the unconditioned stimulus (UCS), the sight, smell, or taste of food (*b*). The salivary response to food occurs because of maturation, prior learning, or both.

The process of conditioning involves presentation of the CS, the light, and the UCS, the food, in close temporal contiguity. This means also that the CS and the UCR, salivation, also occur relatively close in time. In Figure 10.8*c* we see how the CS is presented first, and shortly thereafter the UCS. At this first stage of learning the CS has no effect in behavior that bears any relation to salivation.

When the CS and the UCS are presented together repeatedly, the conditioned response gradually develops. As seen in Figure 10.8*d*, the light alone eventually elicits the salivary secretion. But this salivary response is somewhat different from the unconditioned reaction to the sight and smell of food. It may differ in terms of how fast it occurs after the stimulus is presented or in the degree of strength. Further, it may not be as stable as the UCR. It is more sensitive to interfering factors and, as we shall see, will not persist if the reinforcing stimulus, the food, is not forthcoming. How-

ever, the CR represents a new integration within the response mechanism. Conditioning is a way of changing the organization of the behavior of the individual.

A number of responses of the human individual—the knee jerk, the galvanic skin response, hand withdrawal, and the eye blink, among others—have been studied extensively in laboratory experiments on conditioning. One analysis of the contiguity factor in eye-blink conditioning is shown in Figure 10.9. The UCR, closure of the eyelid, was produced by a puff of air (UCS). The CS was a light of low intensity. To record the CR, a rotating mirror was attached to the eyelid by means of a small lever to reflect a beam of light to the surface of a moving film. Two eye-blink responses are shown in Figure 10.9, first an UCR to the puff of air and the second a CR to light after learning had occurred.

In this and other studies of conditioning it has been found that the time interval between the CS and UCS is a critical factor influencing acquisition of the CR. For the conditioned eye blink, the optimal interval is approximately 0.5 second. Increasing or decreasing the length of the interval reduces the rate of conditioning.

The typical order of stimuli in conditioning is CS followed by UCS, although they may be presented together or in reverse order. If learning occurs when the unconditioned stimulus is presented first, it is called *backward conditioning*. Such learning is much harder to establish and less stable than forward conditioning.

The learning curve in Figure 10.9, showing the typical gradual process of conditioning, was obtained by plotting the percent of CR's which occurred in successive trial periods. This curve is negatively accelerated like most other learning curves; that is, learning occurs rapidly at first and then slows down as the upper limit is approached.

Not all conditioning of human responses requires a long period of training. In some circumstances when strong emotion-producing stimuli occur, conditioning may take place in a very few trials or perhaps a single trial. The conditioned fear of the child Albert, described in Chapter 7, is an example of rapid conditioning.

Reinforcement. The selection of learned responses both in conditioning and in operant learning depends in large part upon the effects of rewards and punish-

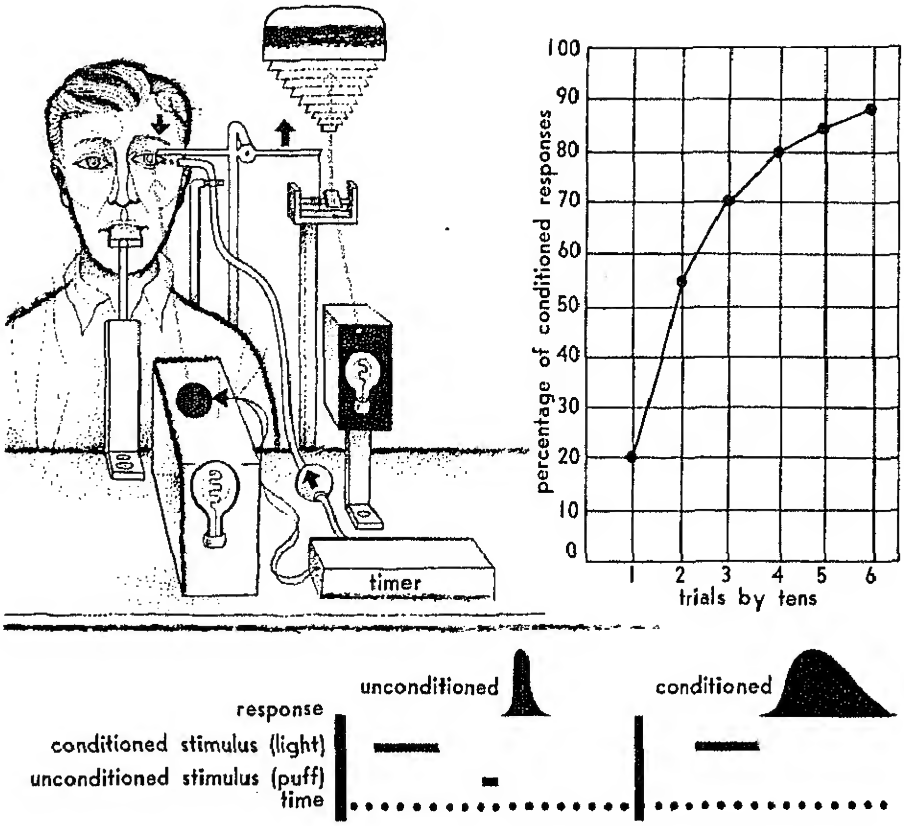
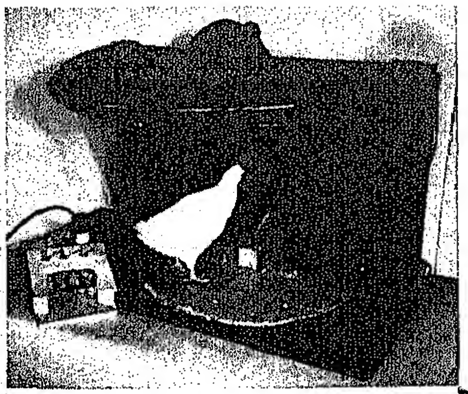


Figure 10.9. Conditioning the eye blink. The apparatus shown presents a light as CS and a puff of air as UCS, and records the time, stimuli, and responses. The graph shows a learning curve for acquisition of the conditioned eye blink. The optimal interval between stimuli for efficient learning was found to be about 0.5 second. (From Kimble, G. A. Conditioning as a function of the time between conditioned and unconditioned stimuli. *J. exp. Psychol.*, 1947, **37**, 1–15; curve from Kimble, G. A. *Principles of general psychology*. New York: Ronald, 1956.)



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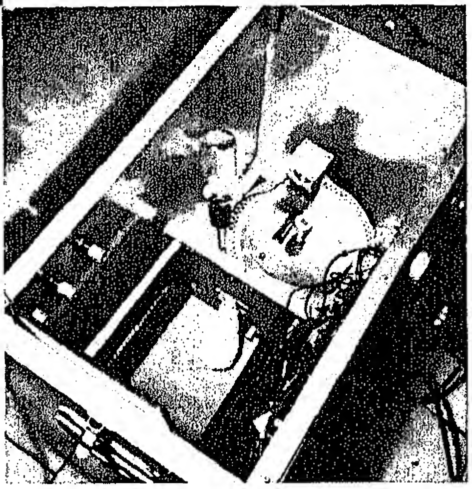

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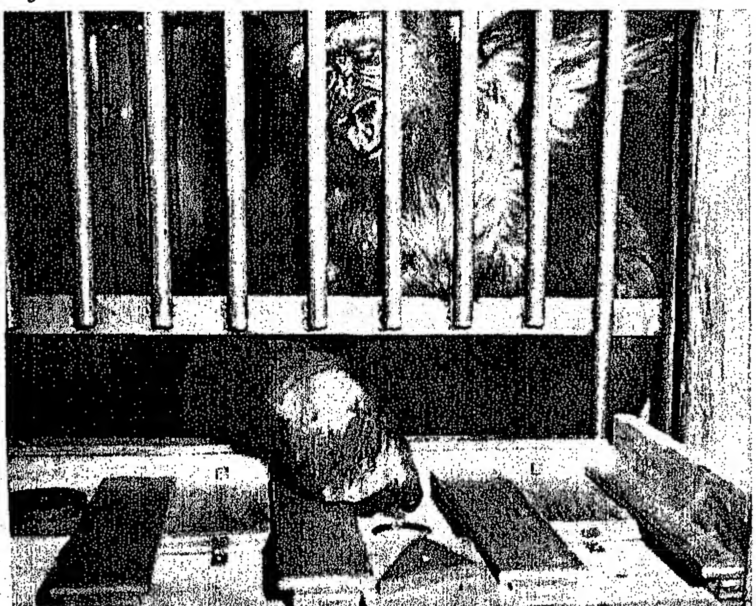


Figure 10.10. Operant reward learning in animals. The pigeon pecks a small disk and the rat presses a lever to get a reward. The gorilla lifts a particular wooden form to obtain the food reward beneath it. (*a* and *b*, courtesy Dr. B. F. Skinner; *c*, courtesy the San Diego Zoo.)

ment—positive and negative reinforcers. Positive reinforcement is found in learning in which rewards (positive reinforcers) are used, or in avoidance learning in which negative reinforcers are withdrawn or avoided.

In reward learning any stimulus or situation (food, money, praise) that fulfills the need of the individual will act as a positive reinforcer. Several examples of the use of rewards in operant learning are shown in Figure 10.10. The pigeon in Figure 10.10*a* pecks a small disk in the center of the apparatus, and is rewarded for his responses with a piece of corn delivered to the food cup. In Figure 10.10*b* the white rat presses a lever and is rewarded by a pellet of rat ration released into the cage by an automatic food-vending device. The gorilla pushes aside a triangular block in order to get a grape located beneath it (Fig. 10.10*c*). In all three of these situations, the learning is controlled by reinforcement in the form of obtaining a positive reinforcer, food.

Avoiding a negative reinforcer, such as some noxious stimulus, also is considered a form of reward learning with positive reinforcement value. The conditioned finger-withdrawal experiment shown in Figure 10.11 is a good example of avoidance learning which includes the use of both positive and negative reinforcers. The CS is a light and the UCS is an electrical shock to the finger, delivered through the key. The subject can prevent the shock from occurring by learning the CR, finger withdrawal. In time, applying a negative reinforcer (shock) and then avoiding it (positive reinforcer) leads to the learned response that avoids the shock altogether.

The CR in this case is clearly adaptive, and learning it is facilitated by the reinforcement associated with avoiding the

noxious stimulus. You probably can think of similar learning in your own experience. The housewife who peels onions under water to keep from crying is showing operant avoidance behavior. So is the person who blows on his hot soup—although he may have something still to learn about table manners.

Negative Reinforcement: Punishment. If a positive reinforcer (reward) is withdrawn or a negative reinforcer (noxious stimulus) is applied, we are providing negative reinforcement. It is a very important problem in child psychology, and educational psychology—and also in family and other everyday situations—to know exactly the role of negative reinforcement in learning. We know that positive reinforcement, especially rewards, is useful in facilitating the acquisition of responses. But does negative reinforcement help eliminate unwanted behavior?

Part of the difficulty in answering this question rests upon our inability to define *punishment* in precise terms. Certain stimuli which lead to pain or fear can be considered punishment. More commonly, punishment can be interpreted only in the light of social context—scolding, frowning, threatening, or enforcing isolation. Furthermore, something that may serve as a punishment one time will function as positive reinforcement at another.

In many experiments mild shocks have been used as punishments, yet it has been shown in both rats and human subjects that learning a maze can be facilitated by using shocks to signal correct turns.[15] In a similar way, spanking a child may function as punishment at one time and be a source of positive reinforcement in a game of "roughhouse" at another. Pain is not necessarily a negative reinforcer, but must be considered in relation to the overall pattern of behavior at the time. A teen-ager, we know, can take a lot of "punishment" in an initiation ceremony without any effect on his social habits in relation to his peers. In this case, the positive effect of being accepted by the group counteracts the negative effect of painful or unpleasant stimuli.

Punishment is commonly used in an effort to eliminate certain patterns of behavior. If the behavior in question is strongly motivated, it probably will survive the assault. Society has never found a foolproof way to punish habitual criminals. Parents who have tried to break bad habits in their children can appreciate the problem. Nagging, scolding—even physical abuse—may cause a temporary suppression of the undesirable activity but produce no permanent change. The same effect was demonstrated in rats which had learned to press the bar in a Skinner box.[16] After learning, the rats were shocked when they touched the bar. The bar-pressing was temporarily suppressed, but after a suitable time (depending on the strength of the shock and the strength of the habit) the habit reappeared as if it had never been punished.

Apparently, the critical factor in the effectiveness of negative reinforcement is whether or not it leads to the formation of a new learned response of avoidance which takes the place of the behavior which is being punished. In the conditioned finger withdrawal in Figure 10.11, the shock facilitated the learning of an avoidance reaction. However, in this case it was not necessary to eliminate a strongly motivated habit; that is, setting up a withdrawal reaction was not difficult because the subject

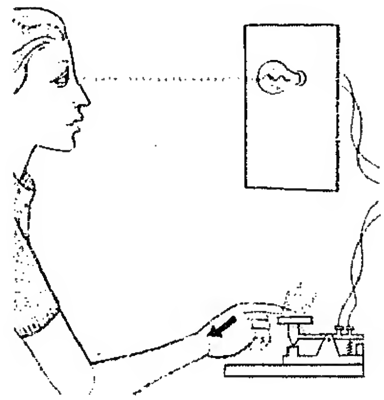


Figure 10.11. Operant avoidance conditioning. The subject can learn to avoid the UCS, a shock to the finger, by reacting to the CS, the light. In a similar form of operant learning, called escape training, the conditioned response terminates a noxious stimulus, but doesn't avoid it entirely.

was not motivated to keep his finger on the key. If punishment is to be used to break up a strong response pattern, it should be applied at the time the stimuli for the response are present, and should be severe enough to provoke a fear reaction. If the emotional reaction is sufficiently strong, a pattern of avoidance behavior may be set up. However, any control of behavior based on strong emotions is unpredictable at best. The mother who wants to train her child not to run into the street and not to play with stoves and matches would do well to set up strong avoidance habits before the undesirable habits have been learned.

When it comes to the matter of teaching desirable habits at home, in school, or at work, the best evidence indicates that positive reinforcement—praise, gold stars, awards—should be used liberally and negative reinforcement used sparingly. The emotional accompaniments and aftereffects of punishment can seriously disrupt the learning process.

Generalization. When we diagram the learning process in terms of temporal patterns of S's and R's, it seems almost as if the organism were a machine into which we feed stimuli and reinforcements and out of which we get learned responses. We all know that behavior is not like that. The precise relationship that we are trying to understand between a stimulus and reinforced response turns out to be not so precise after all, but subject to a great deal of variability. We are going to examine some of the phenomena that account for variability and adaptability in learning.

We have already noted how the phenomenon of *generalization* functions in a learning situation. After the baby Albert was conditioned to fear a rat, he showed fear reactions to a wide variety of furry objects (see page 188f.). In other words, the conditioned response could be elicited by stimuli which had not actually been used in the original learning. Stimulus-generalization is the tendency of an individual to react to stimuli or situations that are different from, but somewhat similar to, a specific stimulus or situation to which a response has been learned. This is a very useful phenomenon in general adjustive behavior. If we were forced to learn how to respond to every new stimulus that presented itself, we probably would not survive. The fact is that individuals "know" a lot more than they have learned in terms of specific S-R associations. A child who has been burned by a candle flame "knows" that he should avoid burning matches, bonfires, and fires in fireplaces. Furthermore, if he has learned the meaning of "hot" in connection with his burn, he also knows enough to avoid hot stoves, "hot" electric wires, and the like. Generalization accounts for the fact that we often can spell words we have never heard before, find our way about in a strange city, and drive a new automobile.

Some examples of generalization in learning drawn both from the laboratory and everyday life are diagrammed in Figure 10.12. The phenomenon has been studied in many experiments in classical conditioning from the time of Pavlov. The dog in Figure 10.12*a* has been conditioned to salivate to a 500-cycle tone. After learning has occurred, a 1000-cycle tone is presented. Some salivation occurs, but not as much as before. Now if a 10,000-cycle tone is introduced, the salivary response probably will be very weak or absent. The amount of generalization varies with the

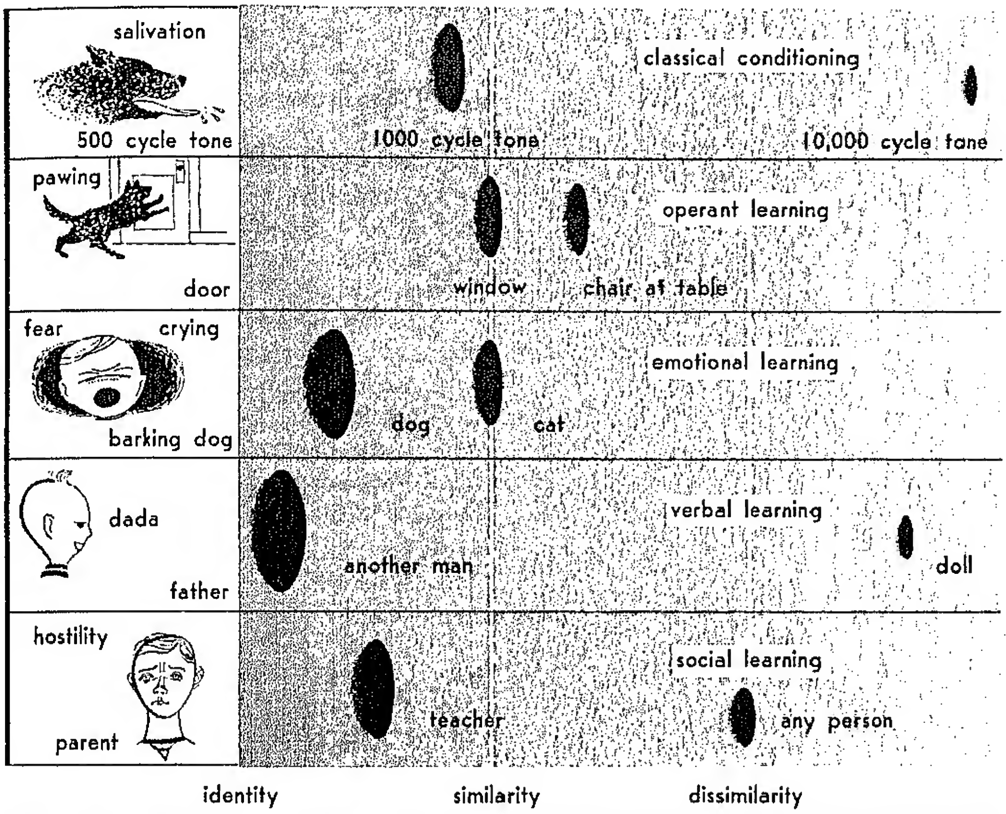


Figure 10.12. Generalization in learning. Learned reactions generalize to stimuli similar to the CS in experiments and in real life. In each instance the point of identity on the scale of similarity represents the stimulus or situation to which learning originally occurred. The learned response occurs less frequently, or to a lesser degree, to stimuli decreasing in similarity.

similarity between the training stimulus and the test stimulus.

The other learning situations in Figure 10.12 show how generalization might vary along a scale of similarity, where the original or "training" stimulus or situation in each case is shown at one end of a scale. Other stimuli or stimulus objects elicit the learned response according to their similarity to the original stimulus. For example, a child who has learned to call his father "da-da" will have a strong tendency to call another man "da-da" and may even use the name for a doll.

The relation between the strength of the generalized response and the similarity of the test stimulus to the training stimulus has been studied quantitatively in various experiments. Thus we have studies dealing with generalization within stimulus dimensions of frequency and intensity of tones, wavelength and intensity of light, and so on.

A well-known study of stimulus generalization of conditioned responses in the human subject is shown in Figure 10.13. The galvanic skin response (GSR), elicited by a mild electric shock as the unconditioned stimulus, was conditioned to a tone. After the CR was established to a tone of a given frequency, tests were made for

generalization with tones differing from the original by known steps. The tones differed in steps of 25 j.n.d.'s (just noticeable differences), making a psychological scale of equal steps. As shown by the curve in Figure 10.13, the more the test stimulus differed from the original CS, the lower was the strength of the response.

Generalization effects are strongest early in the learning process. If only one specific stimulus is reinforced as learning progresses, the individual shows more and more precise *differentiation* of that stimulus. The process of differentiation is roughly the converse of generalization: as one effect increases the other decreases. If one stimulus in a learning situation is always reinforced and all other test stimuli are not reinforced, the ability of the learner to discriminate that type of stimulus can be measured. For example, a subject's ability to differentiate among tones of different frequencies can be determined by reinforcing a CR to one tone and not reinforcing responses to all other tones. A well-trained subject will respond only to the CS and to those other stimuli which are so similar to it that he cannot discriminate the difference.

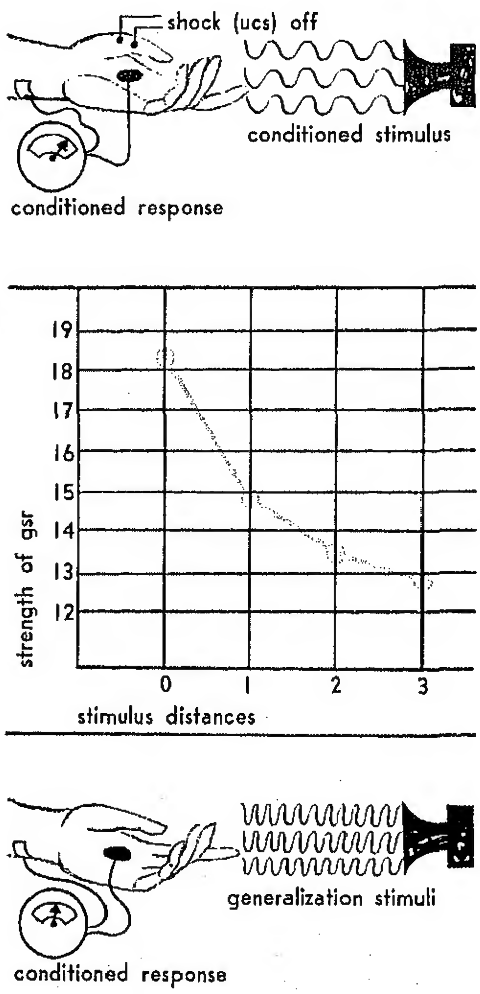


Figure 10.13. Generalization of GSR to auditory stimuli. After the GSR is conditioned to a tone, it can be elicited by other tones with decreasing intensity as similarity of the tone to the CS decreases. Tones 1, 2, and 3 differed from the CS by 25, 50, and 75 j.n.d.'s. (From Hovland, C. I. The generalization of conditioned responses with varying frequencies of tone. *J. gen. Psychol.*, 1937, **17**, 125–148.)

There is another phenomenon of adjustive learning sometimes called *response generalization*. Once a child has learned the way to the corner drugstore, he can get there by walking, running, or riding his tricycle. The patterns of responses made do not necessarily have to be conditioned specifically to the external stimuli. If a student needs to communicate with his parents in a distant city, he can write, telegraph, or telephone. A common feature of operant behavior is that it is usually directed toward a goal or incentive, although the intervening patterns of response may be quite variable. This whole problem is difficult to relate to controlled experimental conditions. It is essentially a question of transfer of training, which we shall take up in the next chapter.

Inhibition. Once a learned response has been established, it cannot be elicited invariably by the appropriate stimulus. Sometimes such physiological conditions as fatigue can interfere with the performance

of a learned act. At other times the presence of new, unusual, or disturbing stimuli acts to inhibit a learned response.

The phenomenon of *stimulus inhibition* is diagrammed in Figure 10.14. The dog has been well trained to salivate to a light as CS. Now if a new stimulus, in this case a loud buzzer, is presented just before the CS, the learned salivary response fails to appear. This type of inhibition is a temporary phenomenon, for the CR reappears when the light is presented later alone.

A learned response, especially in the early stages of learning, is dependent to some extent on the whole environmental situation, not just on the critical stimulus used to elicit the response. For example, an animal which has been trained to give a CR in an experimental apparatus cannot be expected to give the response after it has returned to its home cage. When aspects of the stimulating environment are changed, the learned response may be inhibited. We all have occasions when we "forget" the name of an acquaintance when he appears in an unusual setting. Students often have trouble remembering a well-learned lesson under conditions that are disturbing. Stage fright is the same sort of inhibitory effect.

Temporary inhibition is an interference effect related in some ways to the processes of extinction and forgetting, which we shall take up later.

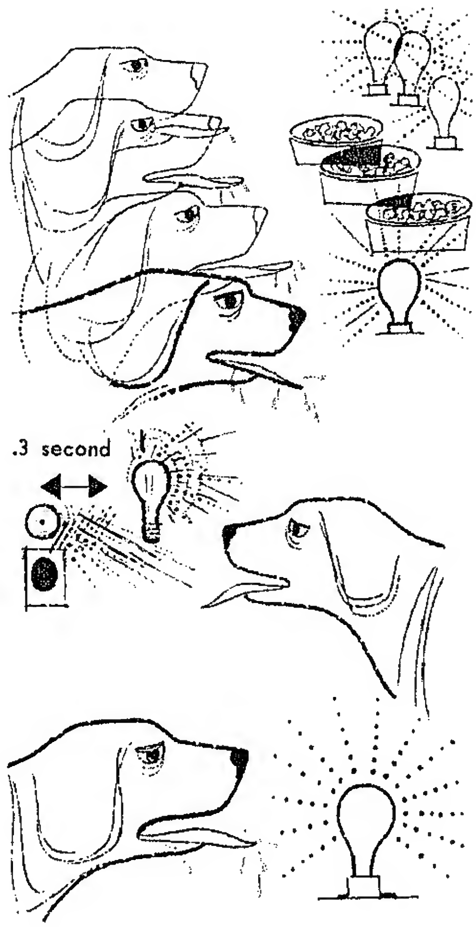
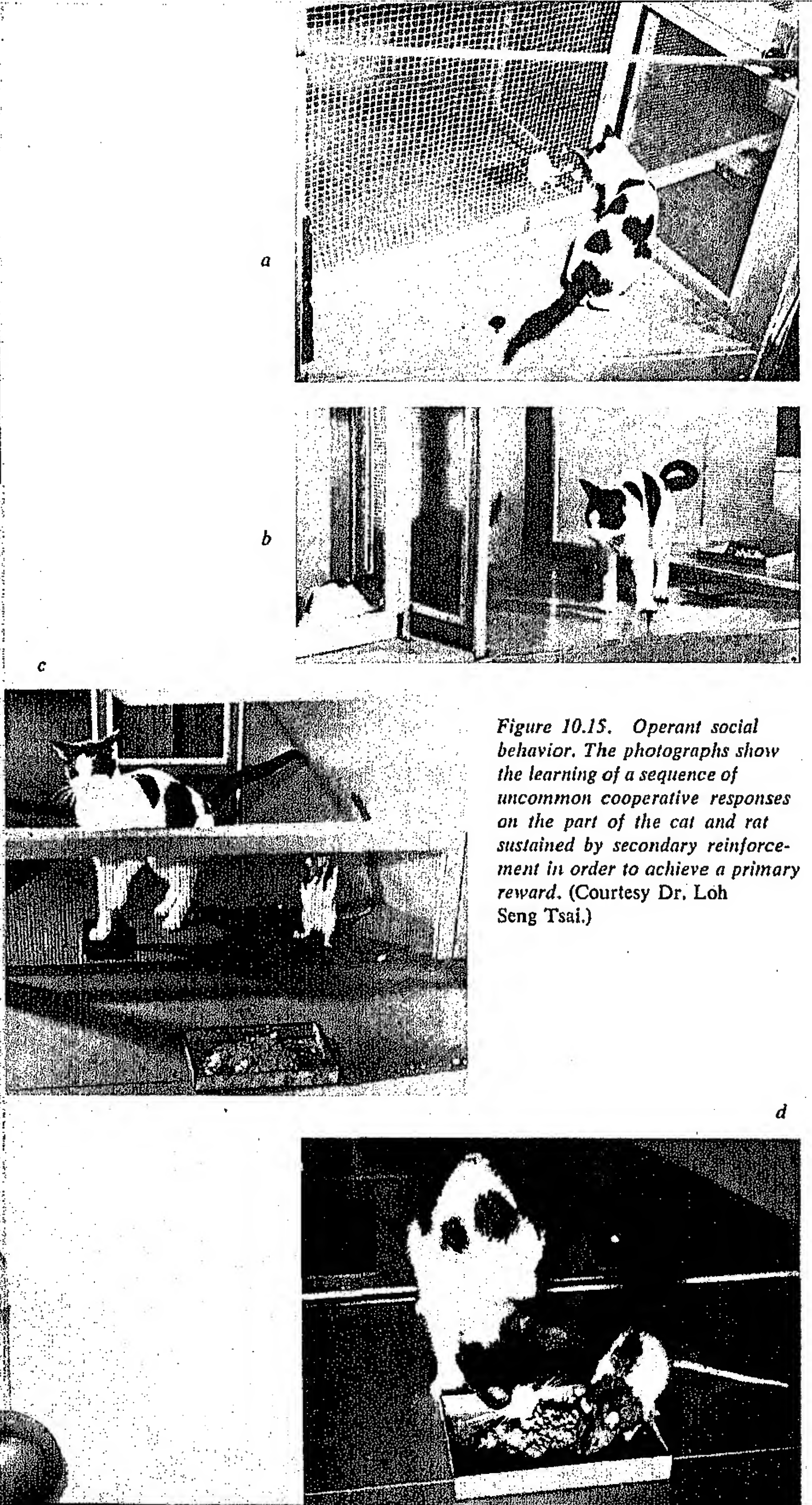


Figure 10.14. Inhibition of a learned response. After the dog has been trained to salivate to the presentation of a light, the response fails to appear if a loud buzzer precedes the light. Later the CR reappears, if no inhibiting stimulus is present.

Secondary Reinforcement. The variability which can be observed in a learned behavior pattern is not confined to stimuli which elicit the pattern and to the nature of the specific responses. The individual also tolerates widely variable conditions of reinforcement in his learning.

We already know from our study of motivation that many motives are learned —from the "token-reward" habits of animals to many of the social and economic motives in human society. Many of the incentives for which we strive have reward value only through learning; that is, they do not satisfy basic physiological drives. Skinner introduced the term *secondary reinforcement* to describe this kind of behavior.[6] He observed that rats which had been given food in an empty box to the accompaniment of a clicking noise would



a

b

c

d

Figure 10.15. Operant social behavior. The photographs show the learning of a sequence of uncommon cooperative responses on the part of the cat and rat sustained by secondary reinforcement in order to achieve a primary reward. (Courtesy Dr. Loh Seng Tsai.)

learn to press a lever to produce the click, even if no food were forthcoming. A number of experiments have been designed to show that almost any stimulus accompanying a primary reward can acquire secondary reward value and serve to reinforce subsequent behavior.

Even though clicks or other incidental stimuli serve to bring about a sequence of behavior, it seems unnecessary to assume that they have acquired special "goal" or "reward" properties.[17] Chimpanzees work for poker chips and rats work for clicks because these tokens are a part of a total stimulating pattern related to receiving food. If the poker chip or the click leads to nothing, the animal gradually ceases to respond to it. In the terminology of conditioned responses, the animals first generalize their responses to many stimuli presented with food, but gradually stop responding to those stimuli that are not reinforced.

On the other hand, stimuli associated with strong negative reinforcement, such as pain or fear, can elicit avoidance behavior for some period of time without additional reinforcement by the original punishment. When rats learn to fear a white box or when babies learn to fear furry objects, these negative "secondary reinforcers" can serve to elicit sequences of behavior almost indefinitely.

Learned social behavior. Much of our learned behavior is based on the secondary reinforcement inherent in social situations. The photographs in Figure 10.15 show stages in an experiment in which a cat and a rat are trained to work in a socially cooperative manner in order to get food. At the start of this experiment the cat was normally aggressive in its behavior toward rats and would attack them if given an

opportunity. Figure 10.15*a* shows the cat trying to get at the rat in the next cage. After a long period of training, however, the cat and rat learned to cooperate in a complex way to receive the food which can be seen behind a screened panel. In Figure 10.15*b* the cat is pressing a button on the floor in order to release the rat into the same cage. The animals must then press two plates on the floor of the cage simultaneously in order to lower the barrier which is keeping them from the food (*c*). The last picture shows them obtaining their reward. Before the animals learned this sequence of responses, the rat might have served as a food reward for the cat if the opportunity had presented itself.

In a recent experimental study of secondary reinforcement in human social behavior, a number of experimenters carried out conversations with people they met in ordinary public places such as restaurants and lounges.[18] In these conversations, the experimenters kept count (without letting it be observed) of the number of times their chosen subjects said something that could be classified as "stating an opinion." Each time the subject stated an opinion, the experimenter, according to plan, said "You're right," or "I agree with you," or "That's so!" or simply nodded or smiled to convey agreement. The different reactions of the experimenter in conveying agreement were considered forms of secondary reinforcement for responses of the subjects in stating opinions.

The results of this study showed that reinforcing the expression of opinions resulted in an increasing number of opinions stated. The longer the subjects talked, the more frequently they expressed opinions. Control subjects who were never reinforced by any form of agreement during conversation showed a decrease in number of opinions stated. All of this happened without the subjects' recognizing their role as "guinea pigs," and without their discriminating the unusual nature of the conversations.

Our whole system of formal education involves learning that finds its major reinforcement in social rewards. Children learn in school largely because they are motivated by their families, teachers, friends—and authorities—to do so. Of course, there are some rewards inherent in the school learning situation—perceptual and activity rewards in seeing, doing, even in thinking. (We shall return to the nature of symbolic motivation in Chap. 12.) However, formal learning would be very haphazard were it not for the reinforcing value of social pressure and social approval.

On the other hand, in order to sustain learning, it is not necessary for a reward or reinforcement to occur after every correct response made. In school and elsewhere, individuals continue to respond and to learn even though reinforcers appear at very irregular intervals, as we shall see.

Partial Reinforcement. When learning is studied in the laboratory, it is possible to reinforce every correct response made by the subject. In ordinary life, however, the conditions of learning are not so consistent. We go through our daily routine responding in the ways we have learned, although frequently there seems to be no immediate reward or reinforcement. To simulate such conditions experimentally, psychologists have studied learning when responses are reinforced only part of the time, a procedure known as *partial reinforcement.* Partial refers to the "program" or "sched-

ule" of application of reinforcers, not to the nature of the reinforcement itself.

Figure 10.16 illustrates different reinforcement schedules which have been used to motivate learning in the pigeon and in the rat. The pigeon pecks the disk on the metal plate and receives a piece of corn, while the rat presses a bar and receives a pellet of food. The schedule of training

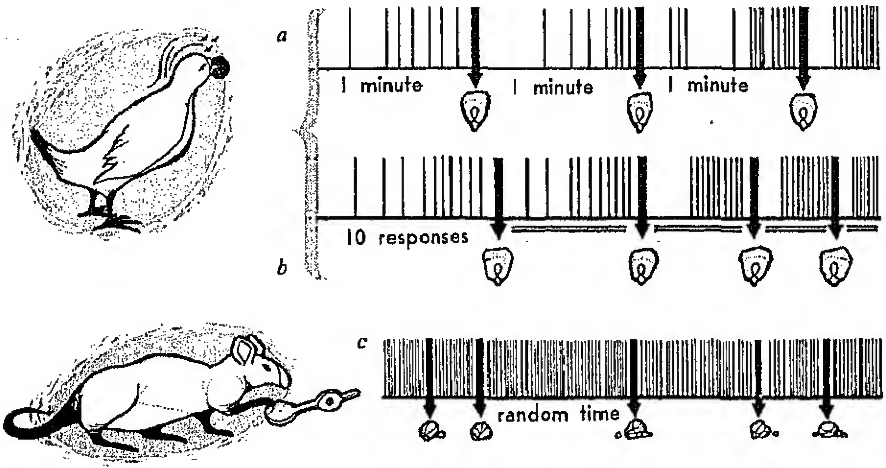


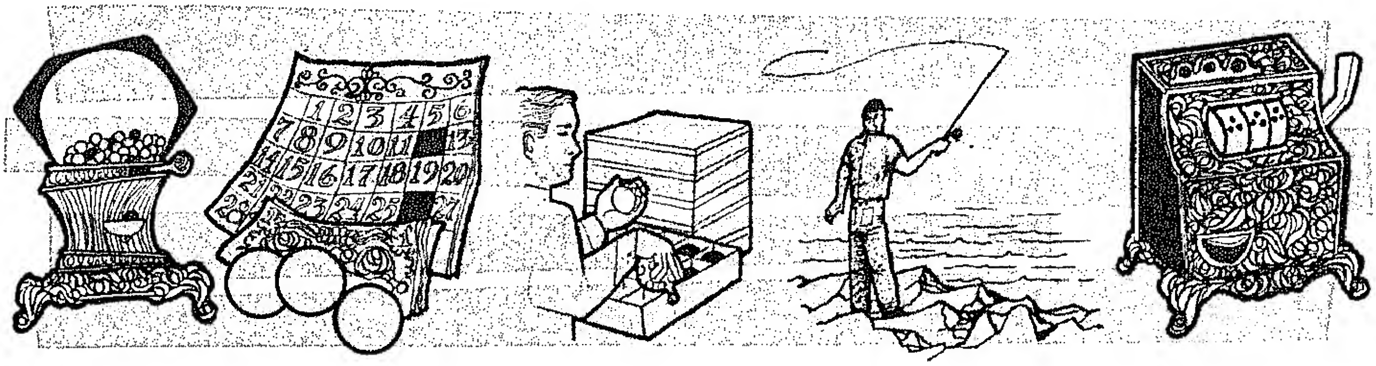
Figure 10.16. Schedules of reinforcement. In the laboratory or in life, people and animals learn many responses under conditions of partial reinforcement. The schedules shown here are known as fixed-interval, fixed-ratio, and aperiodic reinforcement.

can be arranged so that an animal is paid off with food either each time it responds, for 100 percent reinforcement, or only part of the time. In *fixed-interval* reinforcement (*a*) the animal is rewarded after fixed intervals of time—for example, after every minute. In *fixed-ratio* reinforcement the animal is rewarded after it makes a certain number of responses. In Figure 10.16*b* every tenth response is rewarded. Finally, the animal can be rewarded at irregular intervals in a schedule known as *aperiodic* reinforcement (*c*).

According to the results of many experiments, animals will learn a response sequence under any of the reinforcement schedules described. Although the initial learning takes place somewhat more rapidly with 100 percent reinforcement, in some cases learning occurs almost as efficiently with partial reinforcement.[19] Once a learned response has been established, it can be maintained almost as well with partial as with 100 percent reinforcement. This principle is used by animal trainers, who reward animals after a series of correct responses rather than after every response. When the reinforcement is eliminated completely, a habit which has been partially reinforced is much more stable than one which has been reinforced every time. We shall come back to this point in the next section.

Learned behavior in the human individual often can be interpreted in terms of schedules of reinforcement, such as those described for the animal experiments. Some typical situations are described in Figure 10.17. The gum-ball machine operates on a schedule of 100 percent reinforcement (*a*). A penny in the machine invariably produces a gum-ball. Under these conditions learning is quickly established, particularly in children. The regular pay check is an example of fixed-interval reinforcement (*b*). A fixed-ratio schedule is illustrated in Figure 10.17*c*, where the worker is doing piecework and is paid according to the units of work he completes. Many habits related to recreation seem to be based on aperiodic reinforcement schedules. Fishing and gambling (*d* and *e*) are reinforced only at irregular intervals or after an irregular number of responses.

Although the concept of partial reinforcement is an important one in understanding learning, we should proceed with some caution in describing the acquisition and maintenance of complex human be-



a *b* *c* *d* *e*

Figure 10.17. Patterns of reinforcement in human behavior. These real-life situations show 100 percent reinforcement, a, *fixed-interval reinforcement,* b, *fixed-ratio reinforcement,* c, *and aperiodic reinforcement,* d, e. *Although partially reinforced responses are learned more slowly, they also extinguish more slowly.*

haviors—in work, recreation, gambling, and so on—as the result only of specific reinforcements. Almost all patterns of response in the adult human individual are maintained in part by what we might call "built-in" general motives and rewards related to perception, to activity, and to emotional satisfactions or dissatisfactions. Such general motives influence learning in gambling, recreational, and work situations, often just as effectively as the external reinforcements of catching a fish, hitting the jackpot, or getting the monthly pay check. These built-in incentives act to strengthen learned responses just as food promotes the acquisition of food-getting behavior. Moreover, these general motives may account for many of the critical conditions of human learning. The fisherman prefers to fish in pleasant surroundings, even though his chances of success there are slim. The gambler continues playing, even when he isn't winning, because emotional reinforcements support his behavior.

We have seen that learned responses can be acquired under widely different conditions of reinforcement. Do these varying conditions affect the stability of the learned behavior? What happens to the habits if they are no longer reinforced?

Extinction. Once a learned response has been established, it is apt to break down if the reinforcement is withdrawn entirely. The reduction in strength or frequency of a response as a result of repetition without reinforcement is called *extinction*.

The extinction of token-reward responses in cats is illustrated in Figure 10.18. This experiment involved training cats to push a rubber ball into a hole to get food, and then training them to press a string in order to get the ball, as shown in Figure 10.18*a*. When they pushed the ball into a funnel-like hole in the floor, it released the latch of the door, permitting the animal access to the food reward. The cats used in this experiment acquired facility in manipulating the ball into the hole from any position in the box, and then quickly learned to press the string.

After the complete response pattern was established, the cats were tested for extinction. When they pressed the string, no balls appeared (*b*). Records of their responses in this situation are shown in Figure 10.18*c*. Each response is represented by one upward movement of the curves. The cats pressed the string regularly for a time, but after about 23 to 33 unrewarded responses they ceased responding.

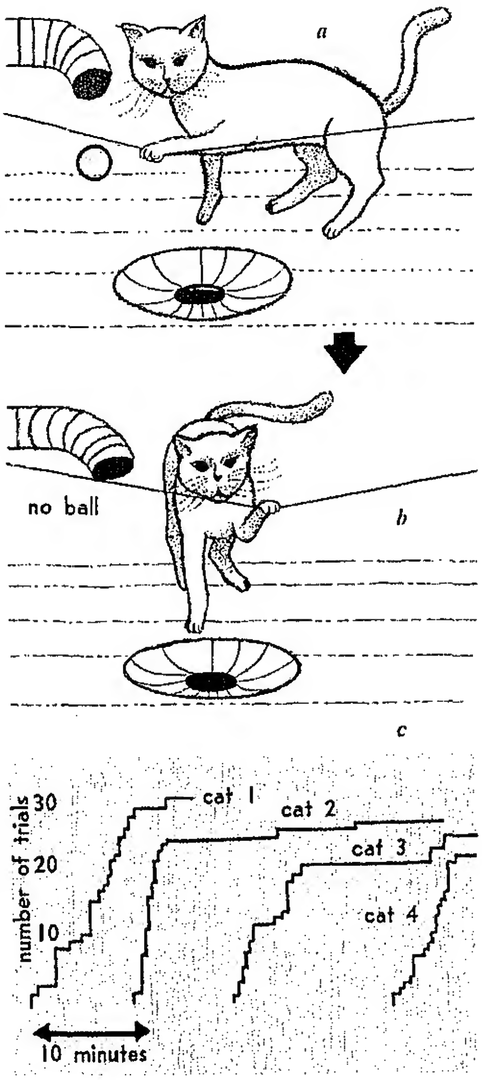


Figure 10.18. Extinction of learned operant behavior. After learning to press a string to get a ball which could be pushed into a hole to secure food, cats were extinguished in the string response by withholding the balls. Extinction curves for four cats are shown. (From Smith, M. F. The establishment and extinction of the token-reward habit in the cat. *J. gen. Psychol.*, 1939, **20**, 475–486.)

These curves of extinction are called *number-versus-time* curves. They exemplify a general method of recording operant behavior developed by Skinner.[6] The slope of the curve indicates the rate of the animal's responses. Notice that the four curves look much the same. They rise rapidly and stop abruptly.

The resistance of a learned response to extinction is one measure of the strength of the habit. The conditions under which the learning took place thus can be evaluated in terms of subsequent extinction. In this study of token-reward habits in cats, extinction procedures were used to compare the stability of the entire string-ball-food response sequence with the response to the string alone. In addition to the extinction curves in the figure, obtained by withholding the balls when the cats pressed the string, other extinction curves were obtained for the complete habit sequence. The subjects pressed the string, received a ball, pushed it into the hole, but then the door did not open. The animals were alternated between one type of extinction and the other with reinforcement trials in between. The results showed no real differences in extinction curves for the token-response and the complete token-food response.

We do not have enough experimental data to tell definitely whether the learned responses produced by primary reinforcement are more or less resistant to extinction than those produced by secondary reinforcement. There are many studies, however, showing that the *pattern* of reinforcement has a direct effect on rate of extinction. As we have said, 100 percent reinforcement makes for faster learning than partial reinforcement, but it also makes for faster extinction. The pigeon and rat in Figure 10.16 will learn faster if reinforced 100 percent of the time, but this 100 percent response will also extinguish faster than a response reinforced by any of the schedules of partial reinforcement. Aperiodic reinforcement, in particular, produces learning that is unusually resistant to extinction. This observation applies to conditioning as well as to operant learning.

The effect of partial reinforcement helps to explain the stability of some of our habits in everyday life. We persist in performing a great variety of lea,ned acts even without any immediate reward. Take the fisherman, for example, in Figure 10.17*d*. He learned this pattern of recreation (we assume) under a very irregular schedule of rewards —aperiodic reinforcement. Now suppose we could arrange it so that he never again caught a fish. How long do you suppose it would take to extinguish the habit? A great many variables would influence this effect, but of one thing we can be sure. The response would extinguish much faster if it had been learned under 100 percent reinforcement than under the actual aperiodic schedule.

We are not sure exactly how to describe the interrelationship between reinforcement and extinction in psychological or physiological terms. In ordinary language we might say that if a person "expects" to be rewarded every time he performs an act, and then the reward fails to appear, the habit breaks down much more quickly than if the person expects a reward only occasionally.

Is extinction the same thing as forgetting? We shall deal with forgetting at greater length in the next chapter, but for the moment shall point out two distinctions that are commonly drawn between these two effects. We say that extinction occurs when a response weakens or dies out while it is being elicited without reinforcement; that is, in order to extinguish a response, it is necessary for the response to occur. Forgetting commonly is thought to be an effect that results during a passage of time while the response is not occurring. The other difference often pointed out is concerned with *spontaneous recovery* of an extinguished response. A response which is extinguished in one nonreinforced session is not lost to the individual. After a time, the response can be observed again. Extinction seems to be a matter of temporary suppression. Forgetting, on the other hand, implies loss through disuse or because of interference by other learned responses.

In spite of these differences, extinction and forgetting may involve one and the same process.[17] Extinction and forgetting, as well as learning itself, describe changes in behavior in which new patterns of response are substituted for old. When a response is extinguished, the subject is learning *not* to respond because the reward is not forthcoming; that is, the extinction can be described as a form of new learning to changed conditions. Even the process of forgetting may be simply a matter of new learning. An old response is "forgotten" because the individual has learned to respond differently. Whether this is an adequate account of forgetting is a matter of conjecture, as we shall see in the next chapter. What we want to emphasize here is that learning, extinction, and forgetting all describe changes in the organization of behavior in response to changed conditions of stimulation. The same principles that account for the acquisition of a response also account for its loss in favor of still other responses.

THEORIES OF LEARNING

A theory of learning attempts to account for the numerous complex facts of human and animal learning in terms of a set of systematic principles. There have been many theories of learning, and as yet psychologists have not been able to agree

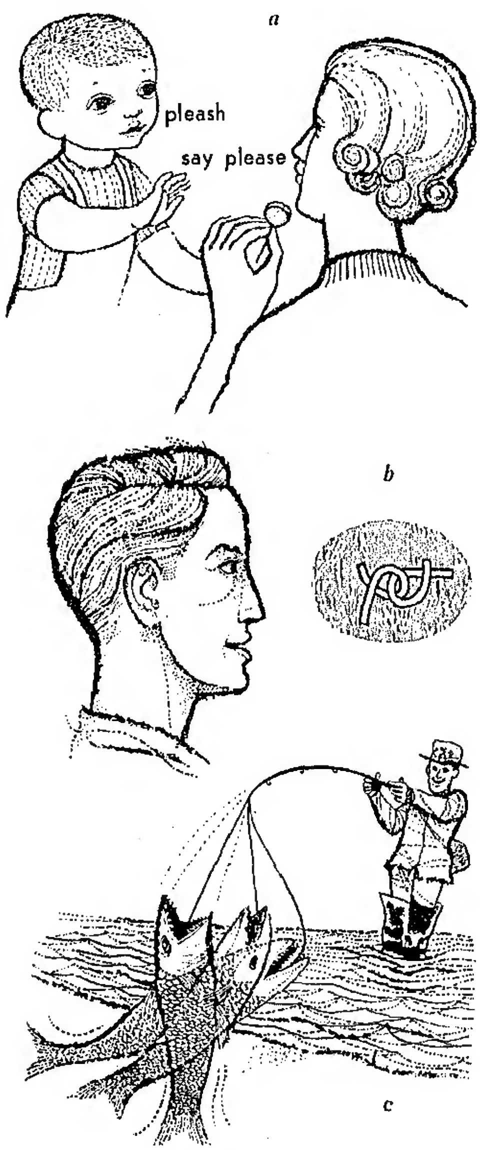


Figure 10.19. Theories of learning. a. *According to contiguity theory, learning is based on the occurrence of stimuli and responses together in time. The factor of reinforcement is incidental and is not considered necessary for learning.* b. *In cognitive theory, learning involves reorganization of the perceptual or cognitive field. Individuals learn certain perceptually organized features of their environment, even though no reinforcement occurs.* c. *Many psychologists hold to some variation of reinforcement theory, in which the fact of reinforcement is a basic condition to learning.*

upon any one of them. No theory accounts satisfactorily for all of the experimental facts of learning. The principle theories today have some areas of agreement, other areas of conflict. They differ also in their main emphases, some of which we can present here.

Contiguity theory. Contiguity theory has emphasized the importance of the close temporal relation between stimulus and response in a learning situation. The most complete presentation of it has been made by Guthrie.[20] Figure 10.19*a* represents the central point of the theory in terms of the contiguity in time of presentation of a sucker and an instruction to a child. The intention is for the child to learn to say "Please" when he wants something. According to the contiguity theory, the presentation of the word with the sucker will result in learning the word, not *because* the child gets the sucker, but simply because the events are close together in time. Reinforcement is not considered necessary for learning. The function of receiving the sucker is to stop a stimulus-response pattern and thus prevent other stimuli from being connected to the reward-getting reaction. The simplest statement of contiguity theory is that stimuli present at the time a response is made will tend to evoke the same response when they recur. In this sense, learning can be considered an "automatic" association of a stimulus pattern and a response.

In contiguity theory, the learning of a specific S-R connection takes place in one trial if at all, and is not strengthened by repetition. In most learning situations many trials are usually needed to establish the effective behavior because the stimulus pattern and the response are never exactly the same. Accordingly, the individual must

learn a whole family of stimulus-response associations in order to meet the demands of the situation.

Contiguity theory claims support from a special type of experimental learning known as *sensory preconditioning*.[21] A dog was stimulated 200 times with paired presentations of a bell and light. Then the bell was used as a CS for leg-withdrawal to shock. When the CR had been established to the bell, the light was presented again. The animal gave the leg-withdrawal response, although the light had never been paired with the shock-withdrawal sequence. It appears that the association of bell and light occurred as a result of temporal contiguity, although no obvious reinforcement occurred. Theorists who emphasize the importance of reinforcement in learning cannot explain easily the phenomenon of sensory preconditioning.

All theories of learning recognize the importance of temporal contiguity, but only contiguity theory assumes that it is the basic and sufficient condition for all learning. Other theories assert that it is but one of a number of factors to be considered in the learning process.

Cognitive theory. Another group of learning theorists agree with contiguity theory insofar as they also believe that reinforcement is not a necessary condition for learning.[22] Cognitive theory emphasizes perceptual reorganization as the essential feature of learning. Individuals perceive the arrangement of stimuli in their environment and in so doing learn certain things about their world, even though no reward or reinforcement is involved. This acquired knowledge may or may not be evident in overt behavior, but the learning has taken place all the same, involving the structuring of the cognitive field of the individual (presumably in the brain) to correspond with the stimulus field.

The main concept of this theory can be illustrated by Figure 10.19*b*. The learning involved in solving the puzzle is not the acquiring of a specific set of movements of the hands. The hands are held back. The individual learns the perceptual relations in this situation, or what-leads-to-what. Once this insight or knowledge is acquired, the necessary movements for separating the parts of the puzzle can be made.

Or, take the example of a rat put in a strange maze for the first time. It has no obvious reinforcement of any kind in this situation, and will not get its food reward until it reaches the end of the maze. Yet during its first trial it learns something of the spatial arrangements of the maze, as evidenced by improved performance in the second trial. According to cognitive theory, the learning that takes place involves perceptual knowledge acquired by the animal, and proceeds independently of the reinforcement.

Reinforcement theory. In spite of the inadequacies pointed up by contiguity and cognitive theorists, some variation of reinforcement theory is held by many psychologists today. Following Thorndike's early formulation of the Law of Effect, there have been several other statements of the principle of reinforcement in learning, including the system proposed by Hull.[23] According to Hull's theory, a stimulus-response pattern or relation is learned specifically in accordance with its effect in reducing some drive or need. Thus his theory is called a *drive-reduction* theory, and reinforcement is the process of drive-reduction.

In Figure 10.19*c* the action of catching

the fish can be thought of as a direct type of reward. Or in drive-reduction terms, the reinforcement is described as the reduction in some emotional or tensional drive state that is effected by the sight and action of catching the fish. The reinforcement serves to establish the movements related to it as a learned response so that the fisherman will not only come back to the same place to fish again but will select the successful movements used in handling his rod and reel.

Reinforcement theory has been applied especially to the interpretation of emotional and avoidance learning.[24] When the individual avoids noxious or painful situations, the reinforcement is said to be the reduction in anxiety brought about by the avoidance. Initial painful or frustrating stimuli in the situation induce the anxiety but do not act as reinforcers. The reduced level of anxiety achieved when these emotion-producing stimuli are avoided acts as the reinforcement.

On the whole, there is little doubt of the observed facts of reinforcement. The manipulation of rewards and incentives in learning is one of the most powerful tools in reorganizing the behavior patterns of the chicken, the rat, the dog, the chimpanzee, the human child or adult. The difficulty is in understanding what reinforcement is in terms of activity within the organism. The whole problem of reinforcement also is related to the nature of motivation, a relationship which is not as yet clearly understood.

In contrast to contiguity theory, which assumes that learning can take place in one trial, reinforcement theory describes learning as a gradual strengthening of response with every trial. Thus every rewarded trial is thought to produce an increment in learning, even though the individual seems to make no progress for a time. However, the validity of the concept of strengthening is not easily proved or disproved. Some theorists, particularly those who hold to the cognitive view, argue that no learning is occurring unless the learner perceives the significant parts of the situation in an organized way.

The theories of learning represent better than any other set of ideas the processes of change in thinking in psychology. In the heyday of behaviorism, attempts were made to reduce all psychological processes to a system of reflex acts. Learning then consisted in forming new associations between specific S's and specific R's. In the last quarter century the inadequacy and artificiality of these concepts have resulted in their widespread rejection.

The critical turn of events in the study of learning in recent years is the recognition of the close relations that exist between emotion, motivation, perception, and the learning process. The notion that temporal contiguity alone can account for learning finds little support among present-day psychologists. Reinforcement—a complex series of events which contains elements of emotion, motivation, and perceptual feedback—is widely emphasized as the principle condition underlying learning. If we extend our description of motivation to cover the general activities associated with perceptual and activity motives and emotion, then our ideas of the nature of reinforcement can be similarly broad. Some of the principle features of cognitive theory can be incorporated into reinforcement theory if we assume that acquiring perceptual knowledge is a motivated *activity,* just as eating and drinking are.

One of the principle advantages of re-

inforcement theory is its emphasis on the active participation of the responding organism in the learning process. Learning is not a blind, automatic connection formed between a stimulus and response which happen to occur together in time. Neither is it a reorganizing process that goes on in the absence of behavior. When the individual acquires perceptual knowledge, *it is* because his behavior is being maintained by an internal motivating state, and because he is actively responding to the events of his perceptual environment.

Learning theory today recognizes that behavior is more than a series of events separated and set apart in time. In a behavior sequence each event can be understood only in relation to the developing pattern of events. Learning, in turn, is more than the acquisition of specific S-R associations. Learning, most of all, is the selection, the rearrangement, the integration, of responses in the sustained and continuing organization of behavior.

SUMMARY

Learning fact and theory have developed around important innovations in experimental method, among which are the use of nonsense syllables, puzzle-box experiments, conditioning, problems in insight, and operant procedures.

The three stages in learning are (1) motivation, (2) trial and error or variability, and (3) selection of a response. In general, responses that lead to satisfaction are selected, while those that lead to dissatisfaction are eliminated.

Learning curves are graphs representing the gradual acquisition of a learned pattern of response in time. They usually are negatively accelerated.

The efficiency of learning is related to the age, intelligence, motivation, participation, learning set, and intention of the individual. Efficiency also is affected by the time between reward and punishment, the pattern of practice, arrangement of task, meaningfulness of material, guidance, and knowledge of results.

In serial learning, the relative distribution of errors throughout the sequence remains fairly constant, irrespective of the kind of material learned or other conditions affecting efficiency. The items at the beginning of a sequence are learned first, then those at the end, with the items just past the middle of the sequence being learned last.

Learning is facilitated by the temporal contiguity of the stimuli and responses involved. Conditioned responses are established more rapidly if the conditioned stimulus precedes the unconditioned stimulus by a short interval.

Learning is facilitated by positive or negative reinforcement. The individual learns responses to attain positive reinforcers and to avoid negative reinforcers. The use of punishment to break up established habit patterns is not often very efficient.

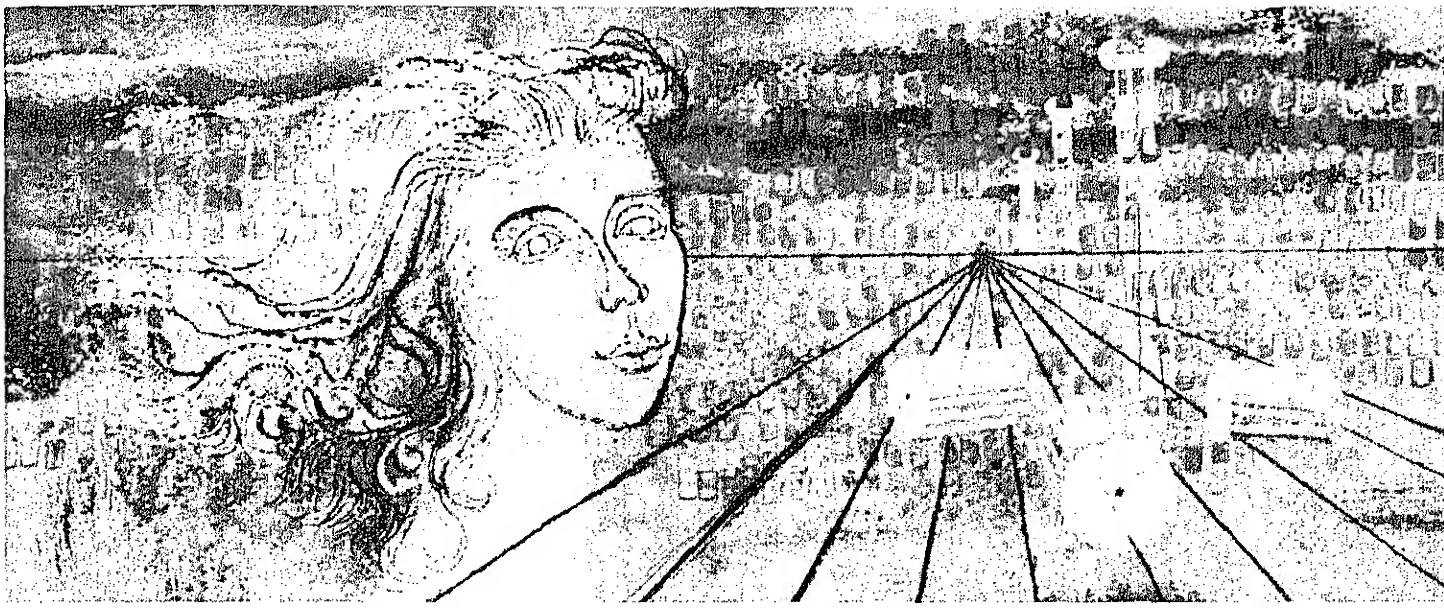
Some of the variability in learned behavior is accounted for by generalization, the tendency of the individual to respond to stimuli that are similar to the learning stimulus. The response patterns used can also be generalized to include many diverse reactions.

A learned response is not always elicited by the appropriate stimulus because it can be inhibited by extraneous stimuli or disturbing conditions.

Conditions of reinforcement also are quite variable. Much learned behavior is

motivated by secondary reinforcers. Learning occurs also in relation to many different patterns of partial reinforcement. When the reinforcement is withdrawn entirely, a response learned under partial reinforcement extinguishes much more slowly than one learned under 100 percent reinforcement.

Different theories of learning emphasize different conditions that contribute to learning. In contiguity theory, the temporal contiguity of the stimulus and response is assumed to be the essential condition for learning to occur. Cognitive theory emphasizes the acquisition of knowledge through reorganization of the perceptual field. Neither of these theories concedes the necessity of reinforcement, a principle which reinforcement theory holds to be the most important one involved in learning.



CHAPTER 11. THE USE OF LEARNED BEHAVIOR

The major problems in the psychology of learning are derived from our daily lives, from the use of learned behavior in knowledge and action. At different times we need to consider a great many phenomena connected with learning—acquisition, practice, transfer of training, memory, forgetting, and even certain abnormal behaviors such as amnesia. Actually, these are all aspects of the general process of change in behavior known as learning. What we are trying to understand is how learned responses are organized and maintained in the continuing behavior of the individual. The fact that behavior is changed through learning implies a modification in the response mechanism. After describing some of the phenomena of transfer, remembering, and forgetting, we shall review current ideas of the neural events related to memory.

TRANSFER EFFECTS IN LEARNING AND MEMORY

In a very real sense *transfer of training*, or *transfer of learning*, is the central problem in all of learning science and theory. No one seriously questions that past experience influences present behavior, in other words, that learning in one situation transfers to another, different situation. The questions are, what kind of learning transfers, and when, and how? Implicit in all our training programs and our entire system of education is a profound faith in

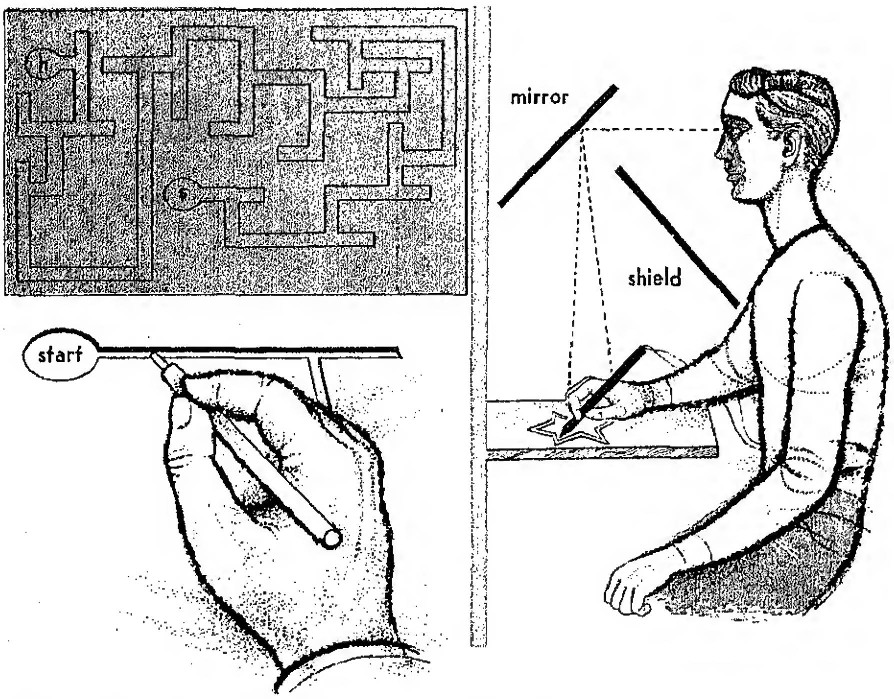


Figure 11.1. Methods of studying bilateral transfer. Maze learning by blindfolded subjects and mirror drawing can be used to study transfer effects from one side of the body to the other. Subjects are first tested for their performance with the nonpreferred hand, and then trained to errorless performance with the preferred hand. A final test with the nonpreferred hand indicates the amount of transfer of training.

transfer of learning, a belief that learning in a training situation will improve performance in a real-life task. However, the difficulties encountered in defining transfer experimentally are enormous. We shall consider first a relatively simple kind of transfer.

Bilateral Transfer of Learning. Have you ever tried to write while holding a pencil in your teeth or between your toes? The resulting scribble will be uneven but probably legible, showing that learning to write with the hands transfers to other movement systems of the body.

When transfer of learning occurs between one hand and the other or one foot and the other, we call it bilateral transfer. Figure 11.1 shows two methods which have been used widely to study transfer between one side of the body and the other. In the mirror-tracing experiment, the subject cannot see the star directly, but must view its reversed image in the mirror, looking over the small screen. He traces the outline of the star between the two lines, attempting not to touch either line. In the maze experiment, blindfolded subjects start at the beginning of the maze path and learn to trace the path with a stylus without entering any of the blind alleys.

To measure bilateral transfer of training in these tasks, the subjects are tested first for their level of performance with the nonpreferred (usually the left) hand. The number of errors made or the elapsed time are used as measures of skill. Then they are trained using the preferred hand until an errorless performance is achieved. Finally, the performance of the nonpreferred hand is determined again. The difference in errors or time between the initial and final tests for the nonpreferred hand indicates an improvement due to transfer of training from the other hand. To make sure that the initial test on the nonpreferred hand does not produce the improvement found after training on the preferred hand, a group of control subjects are run in the experiment. Training with the preferred hand is omitted with them, and they receive only the initial and final tests on the nonpreferred hand. Experiments of this sort show marked bilateral transfer effects; that is, performance in the nonpreferred hand is greatly improved following training of the preferred hand. The transfer of learning from one movement system of the body to another is sometimes called response generalization (see p. 284).

Positive and Negative Transfer. When previous learning facilitates the acquisition

of new behavior, we say that *positive transfer* has taken place. Positive transfer is what we strive for in school and training situations. It is also possible for *negative transfer* effects to occur, when the learning of one pattern of responses hinders or interferes with subsequent learning. This latter effect is also called *habit interference*.

It is not always possible to predict whether one type of learning will result in positive or negative transfer to another type. When both stimulus and response elements in the two situations are very similar, positive transfer will probably result. For example, a person who has learned to drive a car with a standard shift can readily adapt to a different make of car in which the gear shift and other controls operate in the same way. Positive transfer of this sort can often be described as due to stimulus generalization. A somewhat different relationship exists if the stimulating pattern remains much the same but two different types of responses are required in two situations. A person who changes from a standard shift car to automatic transmission usually experiences negative transfer effects.

Suppose we have always locked doors by turning keys toward the lock in locking and away from the lock in unlocking. We can transfer this response from one type of key to other varieties, and even with turning bolt locks can make the necessary manipulation. Now if we encounter for the first time a key that must be turned in the opposite direction, we will get negative transfer or habit interference. As a general rule we say that positive transfer is obtained when old responses are related to new stimuli, and negative transfer when new responses must be related to old stimuli.

Transfer effects sometimes vary with the degree of learning or skill achieved. One might assume that being able to play ping-pong would transfer positively to subsequent learning of tennis or badminton. In the early stages of learning, positive transfer might occur. However, a tennis player who is becoming highly skilled probably would hurt rather than help his game by practicing ping-pong. Many coaches prefer that top-notch athletes do not mix their sports.

Transfer effects are particularly difficult to predict when one is dealing with a highly complex skill. In driving a car or piloting an airplane, or in many other machine-structured skills, a high degree of bilateral coordination must be achieved. Each hand and each foot performs its own movements in response to very specific stimulus signals. Training for these complicated tasks is not effective unless the training situation is highly similar to the real thing. "On the job" training or the use of trainers which simulate the actual machines is necessary in order to insure positive instead of negative transfer.

Practical experience in training situations as well as information from laboratory studies have given us some general guides to follow in the design and use of training procedures for motor performance. We can state some of these principles of transfer as follows:

Transfer of training in motor performance is generally limited to the specific skills involved. The best training in motor skills is usually in the task itself.

Individuals who excel in one skill carry over more from that skill to others than do individuals who have only limited ability in the first skill. We find much the same thing to be true for transfer of training in

school subjects. Individuals with high intelligence transfer more of their learning than do individuals of average or below average intelligence.

There is usually marked bilateral transfer in the learning and use of simplified patterns of movement, but more complex motions may not show such transfer. The *more complex the task the less transfer* can be expected from one task to another or in bilateral transfer.

Transfer depends on the similarity of specific movement components in training and performance. The greater the similarity of these movements in direction, extent, force, and timing, the greater the degree of transfer to be expected. Motion analysis is an essential step in understanding problems of transfer. When we can identify the patterns of movements in different tasks, we can often guess how much transfer will occur between them.

In a particular complex task, one movement component can give a positive transfer effect and another a negative transfer effect. We see both positive and negative effects when experienced operators use a machine or an automobile in which some control has been reversed or changed in direction of movement.

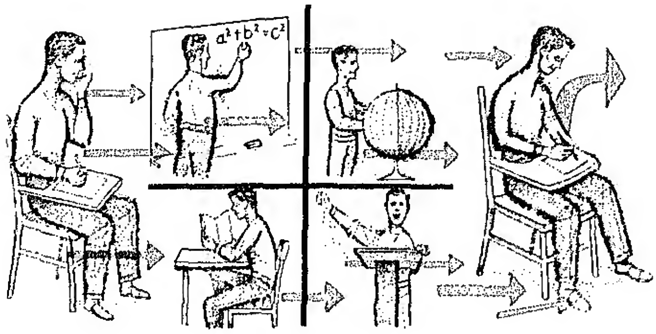
Transfer of Learning in School Subjects. Before the era of experimentation in educational psychology, educators believed that the individual possessed mental powers or faculties that could be developed by "mental exercise." Just as muscular power improves through physical exercise, it was believed that abstract "mental faculties," such as memory or reasoning, would benefit from any formal discipline in which they were used.

William James performed the first experiment in the transfer of "mental" or verbal learning.[1] He memorized a long passage of poetry from Victor Hugo. Then after arduous "memory training" every day for over a month in learning other poetry, he again tested his ability to memorize a passage from Hugo comparable to the first. He found no transfer at all. The second *passage was as difficult to learn as the first.*

The notion that subjects studied in school "train the mind" dies hard. However, after nearly a half-century of experimental work in this field it is now generally believed that the study of Latin teaches the student Latin, but does not improve any general ability to think, memorize, reason, or learn foreign languages. Study of Latin may help slightly, but only slightly, in subsequent study and understanding of the Romance languages and English. The study of algebra and geometry teaches the student algebra and geometry, and helps prepare him for further work in mathematics and science where algebra and geometry are actually *used.*

Some of the most ambitious experiments ever undertaken in this field of transfer of learning were carried out by Thorndike and his associates on thousands of high school students. They were interested in discovering whether general improvement in thinking ability resulted from taking specific courses of study in school.

Students taking part in this experiment were given a series of fourteen tests of different aspects of thinking. They were tested before the start of the school year and again at the end. Gains or losses in scores on the thinking tests were computed with relation to the courses studied during the year. Now in a complicated situation such as this, the effect of taking a course cannot be determined unless other



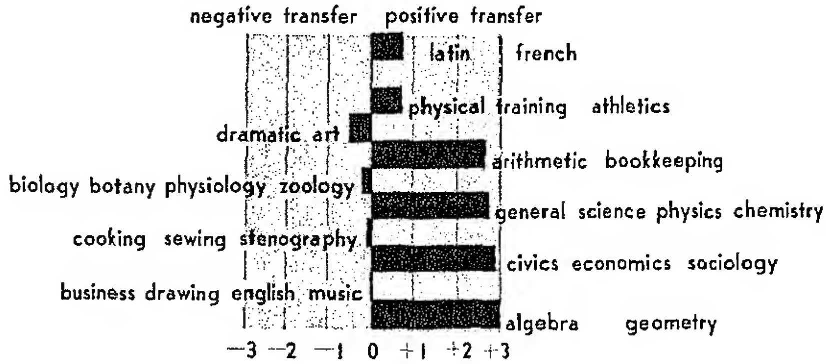


Figure 11.2. Transfer of school training to general thinking ability. Change in thinking test scores of high school students before and after taking specific subjects were compared with scores of equated groups not taking those subjects. The bar graph shows the transfer effects of certain courses on thinking ability, in most cases too small to be significant. (Based on Broyler, C. R., Thorndike, E. L., and Woodyard, E. A second study of mental discipline in high school studies. *J. educ. Psychol.*, 1927, **18**, 377–404.)

variables are equal. For example, a group of students taking Latin cannot be compared with a group not taking Latin unless the groups can be equated in terms of age, sex, intelligence, other courses taken, and so on. If it is not possible to set up actual paired groups of subjects in which all variables are equal except the course in question, allowances can be made for the other variables by statistical procedures.

The results of this study are shown in the bar graph in Figure 11.2. There were some differences in thinking scores which could be related to the courses taken, but the differences were very small and not reliable; that is, some of the differences were not statistically significant (see p. 44). Some specific courses, such as algebra and civics, showed a slight transfer effect to the general abilities tested before and after the school year. Other courses showed practically a zero transfer, or slight negative transfer.

Our schools today show the influence of experimenters such as Thorndike, both in their curriculums and in their methods of teaching. There are more and more courses designed to teach students subject matter directly applicable to present adjustment problems of young people and to vocational problems they will encounter after their schooling is finished. Even in the traditional courses of study, the trend is toward a "realistic" approach, toward seeking out teaching materials which will provide a bridge between the classroom and the world outside.

THE NATURE OF MEMORY

Memory or remembering refers to the retention of learned changes in behavior. Any experience which results in a change in behavior, any single trial in a learning situation which produces an increment in learning, leaves its memory in the individual's response organization. Memory is sometimes thought of as the record of learning within the response mechanism. However, we cannot observe it within the individual; we observe memory only as learned behavior in action, as remembering.

Forms of Remembering. Some kinds of learned behavior are remembered with almost perfect accuracy for long periods of time. Other learning seems more transient. If we are interested in measuring the amount of retention, we must remember

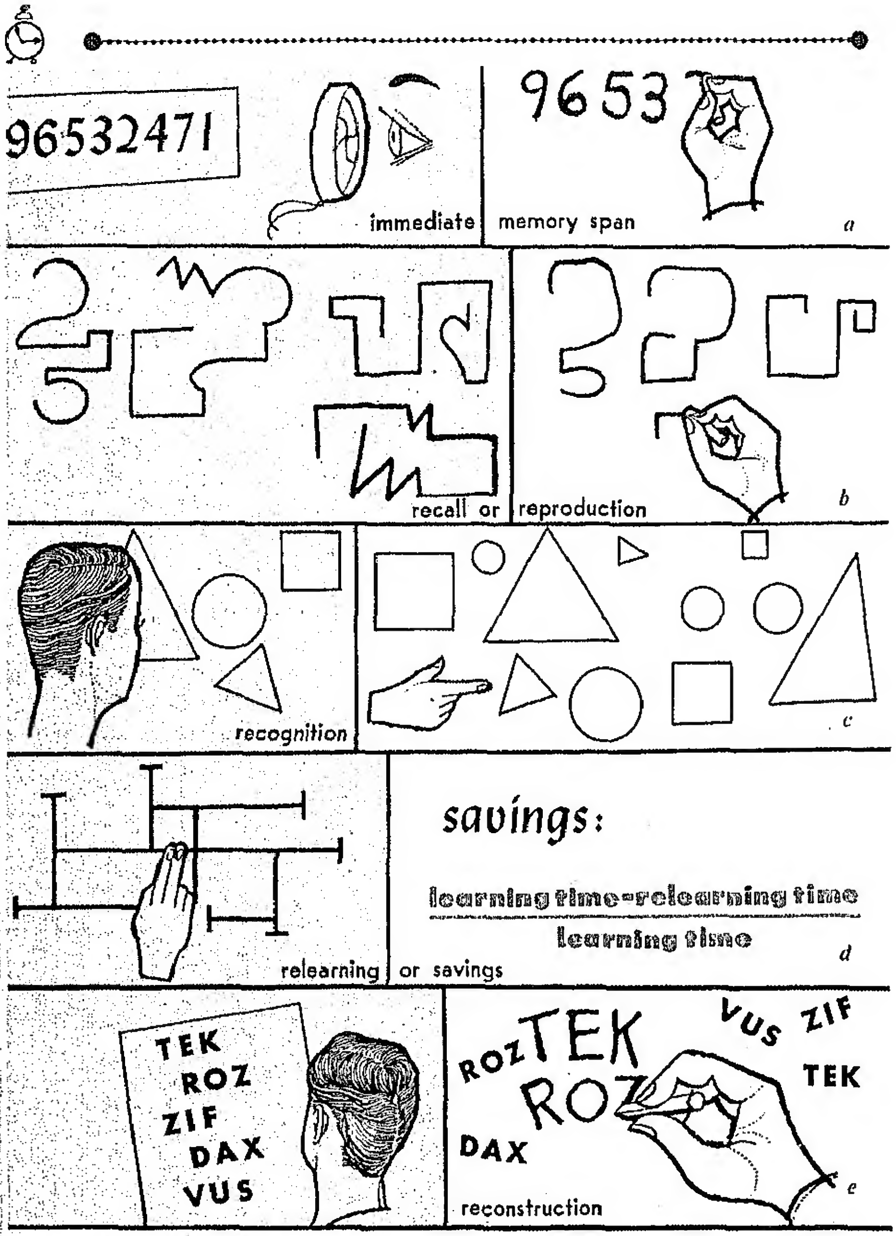


Figure 11.3. Forms of remembering. Several methods of testing memory are illustrated, some of which indicate better memory than others. The measured amount of retention depends on the conditions under which it is tested.

that it depends on the conditions under which the learned behavior is elicited. The amount of memory depends upon its use in a specific pattern of stimulation.

Memory is evident in all types of motor performances which depend upon learning for their development. One kind of evidence for specific memory in animals and young children is the ability to perform a delayed response (see p. 142). Most of the experimental studies of remembering and forgetting, however, are concerned with the retention of verbal material. The learning and retention of words, symbols, and all forms of verbalized behavior are of *prime importance to us throughout most of* our lives. Some of the forms of memory are represented in Figure 11.3.

Memory span. The immediate memory span is the quantity of a given kind of material which can be reproduced perfectly after one presentation. For example, a series of digits is presented visually and the subject is required to write them in order (Fig. 11.3*a*). Digits, letters, syllables, or other forms of material can be used, with either visual or auditory presentation. The span varies somewhat from one trial to another and also with the type of material used. Immediate memory span for digits is about 7 to 8 in adults. It is less for children and also shows some decline with age.

Immediate memory span is closely related to perceptual processes and probably is *organized in terms of perceptions of* space and time. In fact, the number of units that can be perceived in a short interval of time is also known as the span of attention or perception. The number of units perceived can be increased if they are organized into a pattern. Thus the number of letters that are perceived and correctly reproduced is much larger if those

letters are organized into meaningful words than if they are unrelated. We shall see that this is a general feature of memories; meaningful organization facilitates retention.

Recall. A more common form of memory is recall or reproduction (Fig. 11.3*b*), in which the individual tries to reproduce something learned in the past. The essay type of examination question asks for reproduction of learned material. Memory may seem very poor in this form, as it is often difficult to recall learned responses without prompting.

Recognition. An easier way to remember learned behavior is by recognition (Fig. 11.3*c*). This is aided recall, exemplified by the multiple-choice or true-false type of examination question.

Relearning. Sometimes we think we have forgotten something because it cannot be reproduced or recognized. Yet there may be a memory or trace of the former learning that still influences our behavior. This can be demonstrated by relearning the same material. If it can be relearned faster than the original learning, we call the difference a memory *savings*. Figure 11.3*d* illustrates the measurement of savings in learning and relearning a finger maze. If the original learning took 30 minutes and the relearning 15 minutes, we compute the percent of savings as $(30 - 15)/30=50$ percent.

An interesting experiment in memory savings was once carried out by a psychologist with his child.[2] He repeatedly read passages of Sophocles' *Oedipus Tyrannus* in the original Greek to the child when he was fifteen months to three years old. When the child was eight and one-half years old, he was required to learn some of the passages which he had heard as a child, along with new passages of equal difficulty. He memorized the familiar material 27 percent faster than the new material. The child could not possibly recall the Greek passages, and probably could scarcely recognize them. Yet the savings in relearning demonstrated that some memory existed. Other parts of the familiar material were relearned at fourteen years and eighteen years of age. At fourteen there was a savings of only 8 percent and at eighteen, no savings at all. If any memory still persisted, relearning was not a sensitive enough method to demonstrate it.

Memory savings point up the fact that learned behavior which has apparently been forgotten often influences subsequent learning and relearning. Much more is remembered than is directly appreciated by the learner. Guesses, inspirations, and hunches are often guided by such incipient memories and are accurate to the extent that they are so directed. Guessing in an examination should not be discouraged, because it is an aspect of all memory.

Reconstruction. Serial reconstruction in recall (Fig. 11.3*e*) is best known in terms of getting all the facts in order in a good story. Failure to get the punch line in the right place can be disastrous.

The reproduction method is sometimes used to study rumor. It involves telling a story to the first person, having him pass it on to the next, and so on. After a half-dozen or so persons have each passed on his own version, startling variations may appear in the story.

The Curve of Retention. By measuring memory in its different forms as described in Figure 11.3, we can obtain curves of retention or forgetting. Such curves describe quantitatively how well a pattern of behavior is remembered at various points in time

after learning. When we plot retention measures, we get a curve which drops over a period of time. In contrast, a forgetting curve rises.

A number of retention curves are shown in Figure 11.4. It will be seen that they have different shapes, indicating that retention of learned material varies from one time to another. We have already observed that the amount of learned material that can be remembered depends upon the conditions under which retention is measured. The curves in Figure 11.4*a* show the retention of lists of nonsense syllables over a period of two days when measured by the methods of recognition, reconstruction, recall (written reproduction and anticipation), and relearning. With the possible exception of the curve for recognition, the curves drop rapidly at first and then level off. Recognition gives higher retention than reconstruction, and that better than either method of recall.

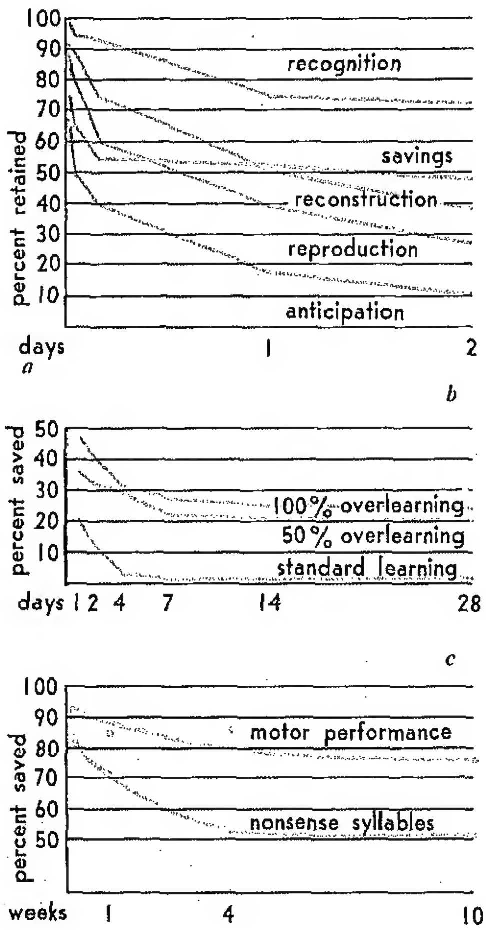


Figure 11.4. Efficiency of retention under different conditions. a. *Measured retention of nonsense syllables varied with different methods of testing.* (From Luh, C. W. The conditions of retention. *Psychol. Monogr.*, 1922, **31**, No. 3.) b. *Retention was improved by continuing the original learning trials beyond the number required for a perfect performance.* (From Krueger W. C. F. The effect of overlearning on retention. *J. exp. Psychol.*, 1929, **12**, 71–78.) c. *Retention of a pursuit rotor task was relatively better than retention of nonsense syllables. However, motor skills are not necessarily retained better than verbal learning, if the two tasks have the same degree of integration.* (From Leavitt, H. J., and Schlosberg, H. The retention of verbal and motor skills. *J. exp. Psychol.*, 1944, **34**, 404–417.)

The curves in Figure 11.4*b* indicate differences in retention due to the degree of original learning. In experiments of this kind, material is considered as having been learned if it can be recited correctly once. *If more learning trials are given after that,* the material is said to be *overlearned.* These curves show retention over a period of 28 days for lists of monosyllabic nouns. Overlearning was defined in terms of the number of extra trials in relation to the trials needed for one correct repetition. Half again as many repetitions as were needed for 100 percent learning was called 50 percent overlearning, while twice as many trials was 100 percent overlearning. It will be seen that retention was better the higher the degree of learning.

Retention also differs with the type of material or task learned. Many experiments have shown that retention of verbal material is poorer for meaningless material such as nonsense syllables than for meaningful material. However, these *differences in retention may not be found if* the two kinds of material are learned at the same rate.[3]

When we compare the retention of verbal material with some kinds of motor learning, we also find differences, as the graph in Figure 11.4*c* shows. The subjects in this study were trained for ten trials in learning a list of nonsense syllables. A memory drum was used to present the

syllables in order and the subjects tried to anticipate each syllable before it appeared. The same 48 subjects also practiced for ten trials on the pursuit rotor, where the task is to keep a stylus on a small round disk located on a rotating plate. The amount of time that the subject stays in contact with the disk is used as a measure of accuracy. In each learning situation the last learning trial was taken as 100 percent, as a basis for comparing measures of retention.

After the learning trials the subjects were divided into four groups of 12 subjects each for retention tests. The groups were tested 1 day, 7 days, 28 days, and 70 days after learning. Retention was measured in terms of percent savings in relearning. The curves show that retention was higher for the motor skill than for nonsense syllables.

The results of this experiment do not mean that motor skills are invariably retained better than verbal material, although this is popularly thought to be true. Skills such as typing and using utensils show high retention over long periods of time. In some cases skills are greatly overlearned, compared with casual verbal learning, and this overlearning may account in part for their superior retention. Another factor is the organization of the task in terms of the individual's abilities and past experience. The pursuit-rotor skill was probably retained better than the nonsense-syllable learning because of the higher degree of integration of the motor skill.

Learned material sometimes undergoes changes in organization which appear when it is recalled or reproduced. The memory may be shortened and lacking in some of the original detail. Often changes occur in line with the individual's other experiences. It is usually a smoothing-out process, in which the specific becomes more general, the unfamiliar more familiar. You probably can demonstrate some qualitative changes in your own memory by using the nonsense forms in Figure 11.5. Look at these forms for two minutes. Wait five minutes and then try to reproduce them with pencil and paper. You may find that the recalled forms are simplified and lacking in detail. Such changes in memory are called *leveling*. They represent change in organization or configuration in perceptual retention.

Fidelity of Report. Memory for events combines all of the features of retention of form, verbal materials, motor responses, and other aspects of behavior. In both conversational reports and sworn testimony, one's memory of observed events can be very faulty, although most individuals report fewer details and are more accurate under oath than ordinarily. To their friends or even to reporters, the eye-witnesses of an accident might relate quite diverse accounts of what occurred. In court their accounts will probably be more subdued and more accurate, although still not entirely in agreement.

There are a number of practical rules one can follow to improve memory not only for accidents and unusual events but for facts, names, and places. Strong intent to perceive and remember is essential for efficient memory. In an accident it is imperative to forget one's own emotional troubles and observe systematically, naming and classifying observed events. The more organized the observations, the better the memory. The details of numbers, measurements, names, and identifications should be written down and not trusted to memory.

Good observation and efficient memory

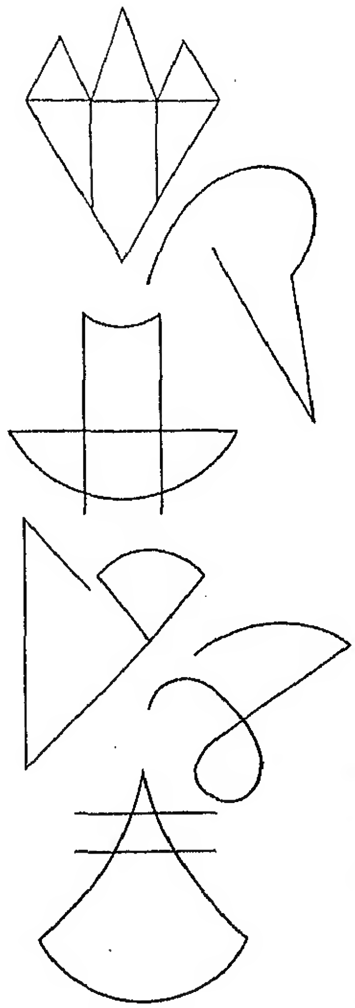


Figure 11.5. Leveling effects in retention. Look at these forms for two minutes and then after five minutes try to reproduce them with pencil and paper. Reproduced forms are typically simplified and lacking in detail. Memory is seldom the passive reconstruction of previous experience. (Adapted from material made available by Dr. Wolfgang Köhler.)

hinge on detailed knowledge of different aspects of the situation. Development of a dependable memory for names, faces, and other events is possible, but this takes systematic long-term work. A car fancier can relate many details of all the cars he has ever owned, as well as descriptions of his friends' cars, but may not remember what necktie he has on without looking. The work involved in memory development involves accumulation of a wide fund of knowledge in terms of which people and events are classified. This process must be accompanied by painstaking observation backed up with records used to systematize facts and people observed. Frequent reexamination and review of available records and memories helps to prevent the curve of retention from dropping too rapidly.

As we indicated in connection with transfer of learning, there is no general memory factor, although there are probably a number of specific memory factors, such as rote memory, meaningful memory, span memory, and the like.[4] Generally speaking, to improve memory for dates, one must develop proper habits of observing, learning, and recalling dates. To improve memory for written material or names, the best approach is to work on these specific aspects of learning.

CONDITIONS OF REMEMBERING AND FORGETTING

Our study of learning and memory brings us inevitably to the simple question, "How do we remember?" or the converse of that question, "Why do we forget?" A popular notion of forgetting is that it is the weakening or fading of learned behavior which has not been used for a period of time. Psychologists have come more and more to believe that forgetting is due not to the passage of time but to what happens during that time. The forgetting of a learned response seems to depend on the interference of intervening activities. We shall come back to this problem of interference later, after considering some of the variables which have an influence upon efficient memory.

Conditions of Learning and Retention. As we have said, any factor which increases the degree of learning also increases retention. The better we have learned something, the better we remember it. When stated in this way, this relationship seems self-evident. However, the degree of learning is not always easy to determine.

The relationship between retention and the amount of overlearning was shown by the curves in Figure 11.4*b*. Clearly, extended practice after a task or lesson has been "just learned" is important if it is to be retained for a long period of time. If you rarely remember the names of the people you meet, the trouble may be that you don't really learn the names in the first place. Courses and books on "developing a good memory" are successful to the extent that they help one acquire efficient learning techniques. They don't "train your memory."

Some of the factors that make for efficient learning have been given previously in Tables 3 and 4 in Chapter 10. Of particular importance is the distribution of practice during acquisition. Material learned by distributed practice is retained better than material learned to the same criterion by massed practice. Although the evidence for this statement is subject to

various interpretations,[5] it is generally accepted as a valid principle of learning and memory.

Memory set. One of the most important factors in efficient learning and memory is that of motivation, including the intent to learn and remember. The attitude that a date, a name, or an appointment must not be forgotten is often enough to keep the retention of the item at a dependable level. Just as a set to learn facilitates acquisition, a set to remember facilitates retention.

The differential effects of memory set and attitudes have been shown in an experiment on nonsense-syllable learning.[6] Different groups of subjects learned lists of nonsense syllables and then were given different instructions. The first group was told simply to come back the next day. A second group was told to come back the next day in order to learn a new list and relearn the old. A third group was told the same as the second, and also told that the new list might interfere with recall of the old. A fourth group was told all this, and was also asked to resist the interference effect. On the second day all groups learned a second list and then were tested for retention of the first list. The results showed the poorest retention for the first group, and better retention for the succeeding groups in the order given. Apparently, the information supplied to the learners helped them develop attitudes or sets that aided memory. The more information they were given, the better they retained the material, and the motivation of trying to "resist" interference helped retention even more.

Emotionally toned learning and retention. It can often be demonstrated that retention is influenced by emotional attitudes of the learner. One experiment studied the effects of "anti" and "pro" attitudes toward communism on the retention of prose material dealing with that topic.[7] Two groups of subjects, one anti- and one pro-communist, learned a prose passage highly favorable to the communist cause and another passage unfavorable. The pro-communist subjects retained more of the favorable passage in a retention test, while the anti-communist subjects retained more of the unfavorable passage. Similar results have been obtained with groups favorable and unfavorable to other political systems of thinking.[8]

Another study compared the degree to which liked, disliked, and indifferent radio commercials were retained and influenced subsequent behavior. In an army camp, a number of different "GI commercials" were prepared urging the soldiers to change shoes each day to the pair not worn the previous day. This was important to foot health, but the soldiers preferred to keep their second pair of shoes shined and ready for inspection. The commercials were tested before a number of soldiers and rated as well liked, disliked, and indifferent. Then they were played over the public address system in messhalls as a part of regular programs of music and news. One company heard only well-liked commercials, another company heard indifferent commercials, while a third heard the disliked commercials.

The results of these procedures are shown in Figure 11.6. When the shoe-change habits of the three different companies were checked after the use of the commercials, it was found that both liked and disliked commercials were retained enough to produce action, but the indifferent commercials had practically no effect. The liked commercials were slightly more effective than the disliked. These re-

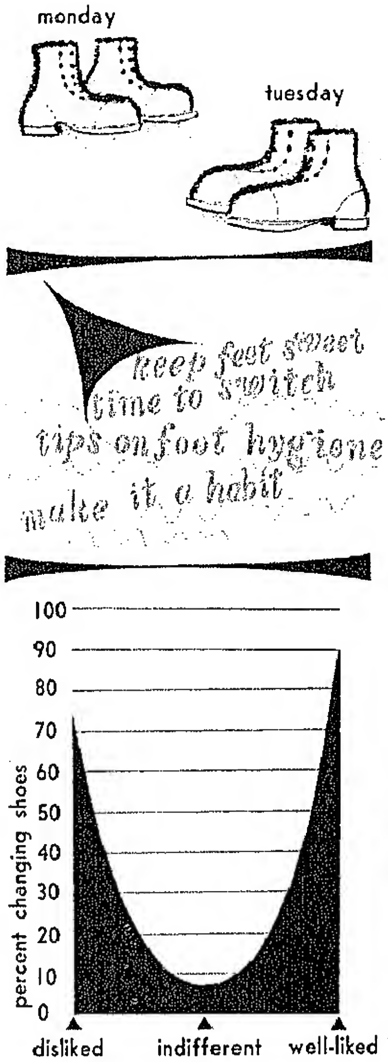


Figure 11.6. Effect of emotional tone of radio commercials on retention. Soldiers bombarded with radio "commercials" telling them to change shoes daily responded well to liked commercials and almost as well to disliked commercials, but largely ignored indifferent material. [From *Schwerin Research Corporation Bulletin*, 1955, 3, (12).]

sults are in keeping with general attitude studies showing that retention of liked advertising displays is generally better than that of disliked displays. An advertisement that meets with indifference is least effective.

Stimulation Conditions in Retention. The success or failure of retention in a given situation depends in part on the stimulating circumstances. We have seen that memories tested by recognition are better than when tested by recall or other methods. All this means is that learned behavior is more likely to be elicited when more stimulus cues are given.

If learning takes place in a very stable situation, retention may be poor when some of the stimulus factors are changed. A student who always studies his lessons in the same room at the same desk may have some difficulty in remembering the right answers in an unfamiliar examination room. It is probably better to conduct practice sessions under varied conditions as much as possible.

Interference in Forgetting. The forgetting of learned behavior can result if some new learning occurs which interferes with previously acquired responses. Assuming that we have a response that was well learned in the first place, and further assuming that the stimulating conditions are sufficient to elicit that response, any failure in retention at this point is due, according to one hypothesis, to interference by subsequent activity.

Retention after inactivity. One way to determine how interference affects retention would be to have a period of complete inactivity follow learning. Although it is impossible for an individual to be completely inactive, we can study the effect on retention of periods of relative inactivity. In a classic experiment along this line it was found that if a period of sleep follows learning, retention is better than when learning is followed by normal waking activity.[9] Two subjects learned nonsense syllables just before going to bed, and in different sessions were tested after one, two, four, and eight hours of sleep. Retention dropped fairly rapidly during the first two hours, but scarcely at all for the remaining sleep period. The drop in retention was much greater when normal waking activity followed learning. Another study of the same kind has demonstrated further that with meaningful material, such as a story, the central features of the story or plot are as well retained after a period of waking as after a period of sleep. However, incidental details are forgotten much more readily after a period of waking.[10]

The same sort of results have been obtained in other studies on human subjects, and also with cockroaches.[11] The cockroach can be immobilized by allowing it to crawl into a small tube lined with soft paper. It will remain there for hours in an inactive state. After a number of cockroaches were taught an avoidance habit to darkness, induced by an electric shock, some of them were immobilized and others were placed in a cage where they remained active. The results showed a clear difference in retention in the two groups. The inactive cockroaches retained the avoidance habit at a very high level even after 24 hours, but the active roaches showed a much more rapid drop in their retention curve.

Reproductive interference. It is easy to demonstrate experimentally that intervening activity can interfere with retention of

a learned response. Experiments studying this problem are designed so that the experimental group of subjects learns A, then learns B, then is tested for retention of A. A control group learns A, then remains inactive (or engages in unrelated activity), and also is tested for retention of A. If retention is poorer in the experimental group, we say that the interpolated learning B has interfered with retention of A.

Suppose you and a friend learn to play chess at the same time. Then you learn to play checkers, while your friend goes to a movie or watches television. Now if you both test your memory for the rules of chess, you may find that your retention is poorer than your friend's because your knowledge of checkers keeps interfering with your knowledge of chess. Of course, this may not happen. It is not always possible to predict in advance whether or not interference will occur. We are dealing here with a type of transfer phenomenon; positive and negative transfer of training depend on a great many variables and cannot always be predicted.

We can arrange some situations, however, where interference is sure to occur. If an individual has learned to type on a standard typewriter keyboard and then is asked to learn a new experimental keyboard which is being tested for efficiency, the new pattern of learning certainly will interfere with the old. In this case the stimuli from the original learning have become associated with a new set of responses in the interpolated learning, with consequent interference with the previous learning. This is very similar to the conditions of experimental extinction, where a learned response is inhibited or interfered with because the subject is learning to respond differently to the same stimuli. (Experimental extinction is usually a negative sort of learning, where the subject learns *not* to respond to the conditioned stimulus.) Inhibition, interference, negative transfer, extinction, forgetting—these may simply be different labels for what is basically the same process.

One additional aspect of interference should be kept in mind. To the extent that learning one thing interferes with the retention of something else, the interference is most effective if the second learning *immediately* follows the first.[12] It is thought by some that there is a kind of consolidation process that occurs immediately after learning. If this process is allowed to take place, then subsequent interference by other learning is apt to be less severe. This general hypothesis is known as the *perseveration* theory. It implies that the process of consolidation or perseveration is a neural one, which is subject to inhibition or interference by other neural activity. Such a theory might account for some aspects of interference or negative transfer, but it does not explain why intervening activities in some cases facilitate the retention of prior learned responses, resulting in positive transfer.

Repression. Freud first used the term repression to describe a kind of selective forgetting which he had observed in his patients. Repression refers to the fact that sometimes extremely unpleasant memories or thoughts are blocked, or forgotten. If the cause of the anxiety can be removed, the repressed memory may be recalled without relearning.

The psychoanalytic view of repression is that it is an active process of submerging unpleasant, anxiety-provoking thoughts into the unconscious. Thus it is believed by many that repression is a special kind of

forgetting. The relation between repression and interference is a controversial issue in the learning field.

It is very difficult to demonstrate repression experimentally, because of the inability or unwillingness of experimenters to induce strong emotions in a laboratory situation. However, a number of experiments which purport to show repression have been carried out. In one study, subjects learned nonsense syllables first and then were given some special tests.[13] At this point the experimenter exposed the subjects to a strongly emotional treatment, telling them they were failing, were not college material, and so on. During the period of anxiety the subjects showed very poor retention of the nonsense syllables, but after they were told the nature of the hoax their retention improved.

A more recent study used personality tests to select subjects who supposedly would be susceptible to repression to a high or low degree.[14] The results showed that such differences in repressive behavior between the two groups of subjects did, in fact, exist. The "high" repressive group showed much poorer retention of anxiety-laden material than of neutral material, whereas the "low" repressive group showed no such difference. However we interpret the nature of repression, the fact is observable that some people apparently are much more susceptible to it than others.

The decisive point in these studies is the demonstration that emotional trauma or anxiety may interfere with retention of prior actions and knowledge. However, there is nothing in our experimental knowledge to date to indicate that any special mechanism is involved in repression. Rather, we can identify it as emotional interference, with learning or with performance in the retention situation. Furthermore, if a stimulating situation evokes an anxiety-laden memory, the individual is motivated to learn an entirely new response to the situation and to forget or "repress" the original response in order to escape the anxiety. The process of forgetting can be attributed to interference, whether by an emotional or other kind of reaction.

Amnesia. Amnesia is an unusual kind of selective forgetting which seems to occur more often in movies and television plays than in real life. Sometimes a severe blow on the head results in a temporary loss of memory for the events which just preceded the injury. Occasionally the victim will go through a period following the injury, during which he appears to be normal but for which he retains no memory whatsoever. The loss of memory for recent events is also observed in mental patients undergoing electroshock therapy, or electric stimulation of the brain.

The more spectacular amnesias, which provide the grist for the pulp mills, involve the individual's more or less complete loss of memory for the details of his life; he may forget even his own identity for a period of time. An amnesia of this sort is quite rare. It may result either from serious physical injury or from an extreme emotional conflict or shock. The loss of memory probably is a result of interference from physiological disturbances brought on by the physical or emotional trauma.

Theories of Forgetting. There is no general agreement among psychologists as to a theoretical interpretation of the facts of remembering and forgetting. The theory of interference is generally accepted, but many feel that this is not the whole answer.

We can summarize the major theoretical ideas of forgetting in Figure 11.7. The first process shown is interference, or blocking. We have dealt with this idea at some length, and need comment no further here.

Gestalt psychology uses the principle of leveling to account for qualitative changes in the organization of memories, such as those observed in retention of the form in Figure 11.7. The loss of detail and simplification that can be shown to occur in memory are difficult to explain in terms of interference. The gestalt idea is that memory is an active organizing process that goes on in time. All memories tend to achieve better configurations by the processes of leveling or simplification. Thus our retention is best for well-organized materials, because these result in the most stable memories.

The *time-decay* or *disuse hypothesis* is the oldest notion of how we forget, but receives little support at the present time. It seems impossible to test behaviorally whether forgetting occurs simply as a result of disuse during the passage of time, and for no other reason. As long as an organism is alive, it can be argued that some kind of activity is always occurring which might interfere with retention. The disuse theory assumes that some kind of neural change or growth takes place during learning which can degenerate if the response is not activated.[15] Our knowledge of neurological processes is too limited to test this hypothesis.

The fourth theory of the forgetting process is the psychoanalytic theory of repression, or selective forgetting, in which painful or unpleasant memories are forced into the unconscious. We have already indicated that repression can be interpreted as a kind of emotional blocking, basically

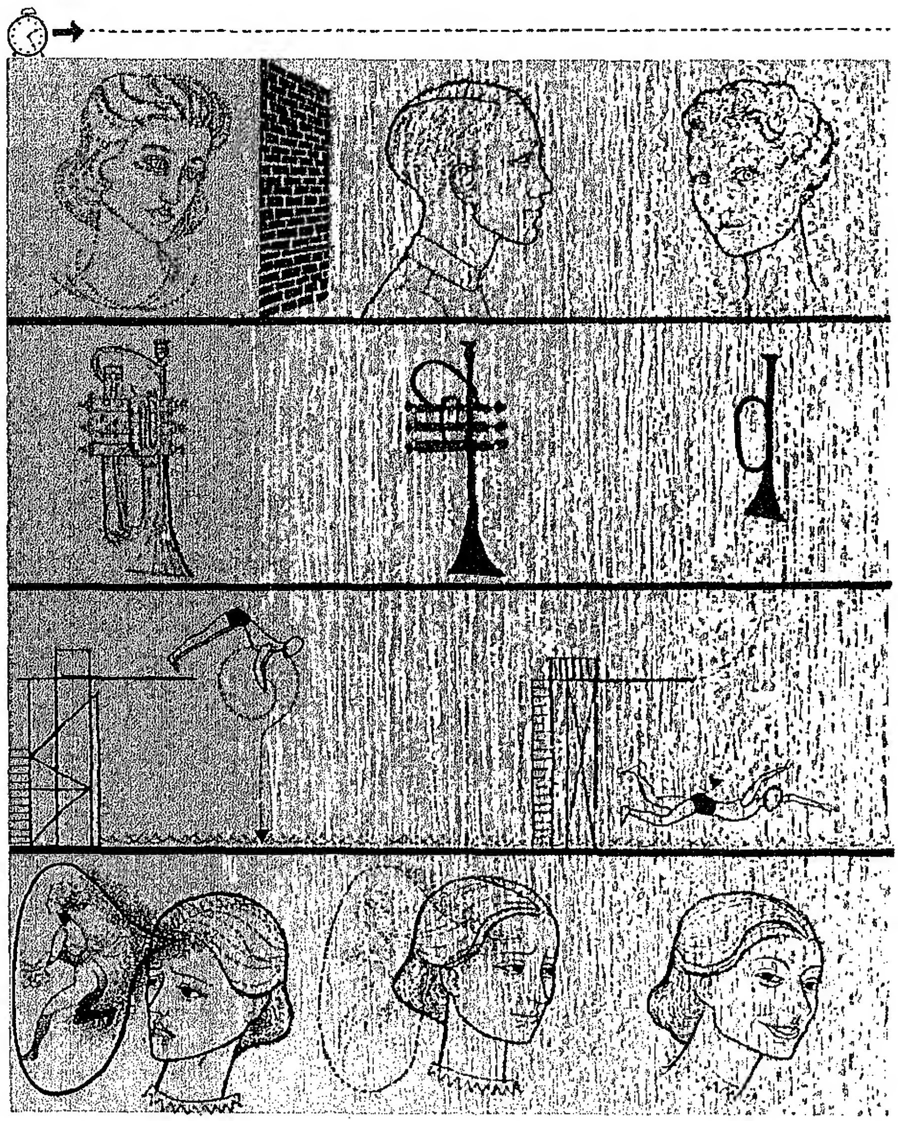


Figure 11.7. Theories of forgetting. The most widely accepted theory is that new experience interferes with or blocks prior experience. Gestalt psychology emphasizes the principle of leveling, the active reorganization of learned material in time. According to the time-decay or disuse hypothesis, forgetting involves degenerative changes in responses that are not used. This theory seems to be most meaningful in accounting for the loss of motor skills (such as diving) that are not practiced. According to psychoanalytic theory, unpleasant memories are actively suppressed.

no different from other kinds of interference.

Of these four views of the forgetting process, the most widely accepted is the interference theory. While the gestalt theory is based on the assumption that changes occur in memory traces independent of experience, interference theory attributes forgetting to the direct effects of behavioral experience. Experimental evidence favors interference theory.

ORGANIZATION OF MEMORY

A recurring question in our study of learning and memory concerns itself with the organization of memory. Why do we remember some things better than others? How are memories organized in relation to behavior as a whole? Does memory change with age?

In learning and memory, as in other psychological functions, we are concerned with patterns of integrated behavior. We do not learn and remember series of discrete, independent reactions, but patterns of behavior which are related to what has gone before and are remembered in relation to what comes after. The single stimulus which becomes attached to the single response is a theoretical concept with little relation to reality. Even Pavlov's dogs could not be conditioned until they were emotionally adapted to the laboratory situation, until they were quiet, cooperative, and ready to learn.

Perhaps the most important integrative principle in memory is that of past experience. We learn and retain more easily that material which has meaning to us. If we have a large body of knowledge in one particular area, it is fairly easy to remember new details that fit into the general picture. Learning a list of the vice-presidents of the United States would present quite a problem to some people, but a student of American history could do it with little effort. Furthermore, the changes and distortions of memory in time are likely to be structured by past experience, by objects and events that are familiar to us. The continuous active organization of our memories into meaningful structures has been called the development of "schemata."[16]

Memory is more efficient if it is integrated into overall patterns of behavior. We have already emphasized the importance of a learning set or attitude. We have also seen that learning based on pleasant or unpleasant emotions (if the individual does not find it necessary to repress it) is more easily remembered than "neutral" learning.

Some material is learned and remembered efficiently because it readily falls into patterns or configurations. For example, passages of poetry are learned and retained better than passages of prose. The rhythmic pattern gives us a form on which we can hang individual words and phrases. Sometimes we employ mnemonic devices to remember useful information which taken in and of itself has little or no pattern. The familiar "Thirty days hath September . . ." achieves a certain pattern for the numbers of days in the months which they do not have otherwise.

Perceptual Patterns in Memory. There are wide individual variations in memory of perceptual events. One fairly rare kind of visual memory, known as *eidetic imagery,* is marked by almost perfect recall of visually presented stimuli. A person with this ability can look at a picture momen-

tarily and later recall practically every detail in it. Details apparently not "seen" at the time of observation can be recalled later. Many more children than adults have eidetic imagery.

Occasionally, a person turns up who has an almost uncanny ability to remember numbers and perform complicated calculations "in his head." We have no ready explanation for unusual abilities of this sort. They may appear in persons of otherwise quite ordinary capacities.

The retention and use of numbers and other symbols is apparently facilitated in some individuals by organizing the memories of the abstractions into perceptual patterns. Figure 11.8 is an attempt to portray the *memory forms* of a woman of superior ability in the use of numbers. Since childhood, she has always "seen" numbers as arranged in a visual pattern. As seen in Figure 11.8, there is a fairly slow upward swing from 0 to 20, then a turn upward, a dog-leg in the pattern which takes care of 40 to 50, another upward turn, and then at about 100 a swing toward the left. From here the numbers go "on and on." This woman sees the dates in the twentieth century in a similar pattern, and can "handle" the dates in the nineteenth century in a somewhat poorer fashion since they are "so far away." Her memory forms for the months of the year and days of the week also are shown.

Do you personally have memory forms by means of which you organize knowledge? If you do, have you ever realized their existence up to now?

Memory forms are an aspect of a very common property of recall: its frequent organization in terms of positions and directions in space. Many memories are identified as having a particular place and

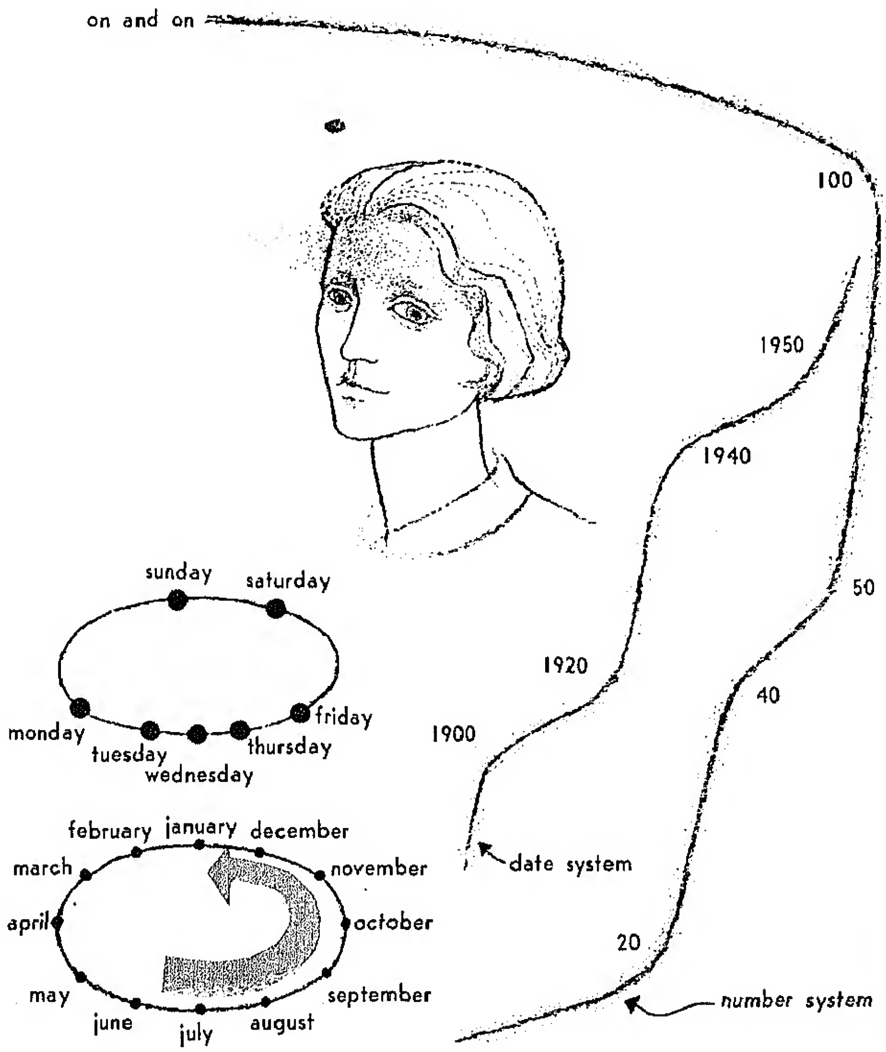


Figure 11.8. Memory forms. Some people remember and "keep track of" numbers, dates, and other learned material in terms of spatially organized patterns. These are the memory forms of a woman as nearly as they can be represented visually. It is well known that learned material with organization and pattern is retained more efficiently than haphazard material. The individual who develops memory forms may not be aware of them, but they apparently facilitate his retention of past experiences.

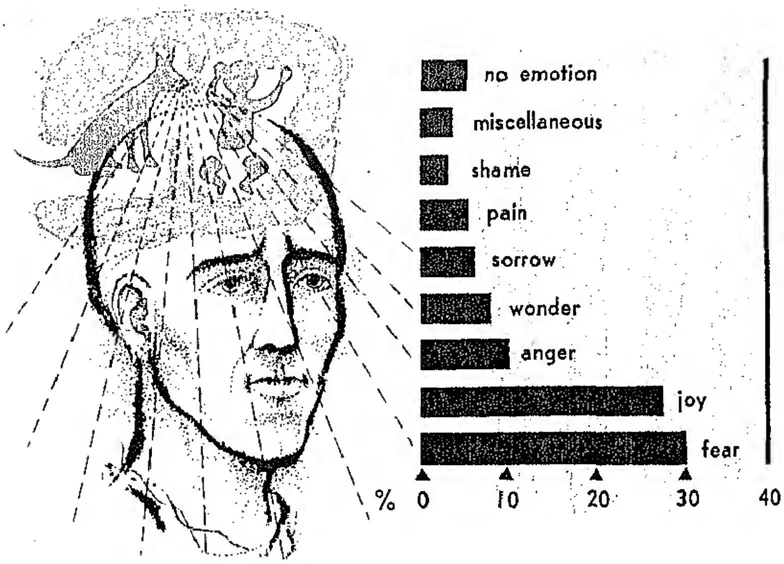


Figure 11.9. Earliest childhood memories. Of more than 200 earliest memories reported by college students, almost all were emotionally toned. (Based on Dudycha, G. J., and Dudycha, M. M. Some factors and characteristics of childhood memories. *Child Develpm.*, 1933, 4, 265–278.)

position, and a less clear identification in time. The temporal arrangement of retained experience often is telescoped so that the time factor, except for the time of recent events, comes to mean little or nothing.

Memory and Age. Most people report their earliest memories of events that occurred from three to five years of age. Sometimes we hear reports of memories aroused during hypnosis or by other means which go back into early infancy, to the time of birth, or even into fetal life. It is hard to believe these stories, and even harder to check their accuracy. It is possible that a simple kind of learning can occur during the late fetal or neonatal period (see p. 135ff.) and it is also possible to demonstrate transient memory during the first year or so of life by the delayed response technique. However, lasting memories apparently date from somewhat later in childhood.

According to one study, the earliest remembered experiences usually have an emotional tone. The percentage occurrence of the various emotions which were reported is shown by the bar graph in Figure 11.9. Here again we see the importance of overall patterns of motivation and emotion in retention.

Although memories occur in time, there are no blank spots in the record representing periods of sleep or long illness. Memory in this sense is not an imprint of the past. It is a reproduction of responses related to events that have occurred in the past.

Retention seems to become less efficient with age, but this change may be more apparent than real. Childhood memories are often just as clear in old age as at any other time of life. In fact, many old people spend a lot of time "reliving" their earlier experiences. The decline in retention for recent events which we observe in the aged is probably the result of less efficient learning due to many reasons. Older people often are handicapped by reduced sensory and motor abilities and thus do not perceive as well as younger people. Furthermore, their level of motivation for acquiring new knowledge and "keeping up with the world" often drops markedly. Whether memory is further hampered by degenerative changes in the nervous system is not clear.

LEARNING, MEMORY, AND THE BRAIN

Since a fifteenth-century anatomist first dissected the human nervous system, it has been a firm belief of biological scientists that memory is specifically located within the brain. This belief in the locus of memory is no doubt true in part. Gross injuries to the brain usually impair memory and the ability to learn. A stroke may

leave an individual with a nearly complete loss of the use of language and other abilities.

In more recent times, many physiologists and psychologists have developed the idea that the neural network of the brain is a recording system for learning and memory. Some believe that learning involves the changing of electric resistance at synapses between specific neurones. Thus memory is thought to represent the persistence of this synaptic change. Forgetting is explained by the idea that this change decays in time or is interfered with by new learning. The nervous system as a whole might be compared to a telephone network with the brain as the primary relay and recording station.

Experimental studies of the role of the brain in learning and memory deal with one of the most interesting but yet most difficult problems in science. Many types of experimental approach have been brought to bear on this problem in the past several decades. We can describe the overall results of studies in this area by saying that both learning and memory are now thought to depend on general integrative changes between organ systems or general functional regions within the brain rather than upon changes which take place at specific synapses.

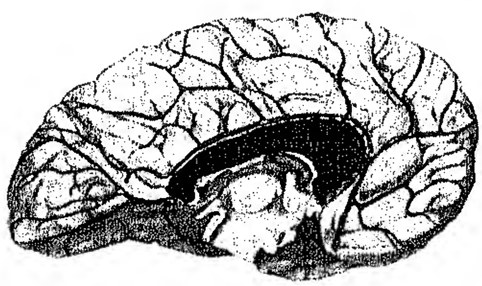
Some of the first comprehensive studies of the relation of memory function to areas of the brain were carried out by Lashley.[17] Rats were trained in maze learning or in discrimination habits and then subjected to operations in which parts of the brain were destroyed. After recovery, the animals were retrained to determine the number of trials needed to relearn the original habits. Finally, the animals were sacrificed and histological studies were made to plot the area and extent of destruction in the brain.

These studies showed that lesions of the brain produced losses in retention, and that the more extensive the lesion, the greater the loss in retention of a maze habit. The interpretation of these studies is still debatable, but Lashley did demonstrate that memory and learning are not located in particular places in the cortex, and that they are not dependent on *specific* neural connections within the brain.

Similar studies of the effects of brain lesions upon memory and learning sometimes can be carried out with human patients who have undergone neurosurgery for therapeutic reasons. One such study is illustrated in Figure 11.10. The primary purpose of the neurosurgery which was performed on the subjects of this experiment was to reduce the severity of epileptic seizures by cutting the nerve fibers which connect the two cerebral hemispheres.[18] The darkened area in the drawing of the brain (Fig. 11.10*a*) shows the extent to which this interconnecting band of nerve fibers, the *corpus callosum*, was cut in one particular case.

For some two weeks prior to surgery, the subjects in this experiment were tested and observed in various activities, some already learned and some in which they

a



b

Figure 11.10. Effects on learned behavior of cutting the corpus callosum. Surgical section of the large band of fibers that connect the two sides of the brain, a, *had very little effect on skilled manual behavior, performed with either hand,* b. (From Smith, K. U., and Akelaitis, A. J. Studies on the corpus callosum: I. Laterality in behavior and bilateral motor organization in man before and after section of the corpus callosum. *Arch. Neurol. Psychiat.*, 1942, 47, 519–543.)

had to be trained. For example, samples of writing and drawing were obtained from them, as shown in Figure 11.10*b*. They were also trained in mirror drawing and maze learning (see Fig. 11.1). Measures of bilateral transfer of learning from the preferred to the nonpreferred hand were obtained in both of these tests.

Beginning very shortly after the operation, tests of memory were conducted for the various tasks which had been observed preoperatively. Figure 11.10*b* shows samples of drawing and writing by one of the subjects obtained before the operation, and similar samples obtained one and three days after the association pathways between the two hemispheres had been cut. One patient, Frank, wrote his name one day after the operation about as well as he could before. This same patient could write and draw very well with his left hand, and could still do so without much disturbance after the operation.

When retention tests of the maze performance and mirror drawing were conducted about one month after the operation, the patients showed no losses in memory. However, they did show limited interference in their ability to transfer learning in maze performance from the preferred side of the body to the nonpreferred.

Comparable studies of the effects of cutting associative nerve connections have been carried out with rats.[19] The animal and human studies are in general agreement; that is, both show that memory of highly coordinated motor skills does not depend on specific connections within the cerebral cortex. The cutting of millions of interhemispheral association fibers in the epileptic patients did not disturb their memories of complex tasks and skills. The very limited losses in verbal and motor abilities in more than twenty patients suggest that neural changes related to memory are widely distributed, and not localized in particular parts of the cortex.

Early clinical observations of effects of injury to the frontal lobes of the cortex led to the belief that these association areas were the storehouse for memory. These notions were strengthened by studies carried out in the early '30's showing that monkeys with the prefrontal association areas removed were hampered in their ability to perform delayed reactions.[20] More recently, however, these ideas have had to be revised. General destruction of the neural connections of the prefrontal areas in man does not impair memory in any serious way. We know this from results of a surgical procedure called prefrontal lobotomy, in which the front part of the brain is separated from the remainder by cutting, although none of the brain is actually removed. This procedure has been used to alleviate extreme emotional depression in mental patients. Further delayed reaction studies on monkeys have shown that prefrontal monkeys can perform a delayed reaction if the test situation is controlled so as to sustain their motivation and attention.[21] The best statement that we can make now about the prefrontal areas in learning and memory is that these areas of the brain are closely related to the hypothalamus and are involved in motivation and general level of activity. The frontal lobes probably participate in all integrative actions of the body which involve the interrelation of the thalamic and glandular systems with overt muscular action.

Other studies of brain function have given a somewhat different picture of memory and the brain. Penfield and Rasmussen have used the technique of stim-

ulating the brain by means of electric currents in some 400 epileptic patients, with the view of developing methods of treatment.[22] The exploration of the cortex is performed under local anesthesia so that the patient can report the effects of the electric stimulation. One remarkable finding of these investigations is that some patients, when stimulated in the region of the temporal lobe, report memories of songs, events, and dreams that have previously been associated with epileptic attacks. The memories described by the patients are of an organized perceptual nature, and do not involve specific words or movement skills. We cannot as yet evaluate these results conclusively.

A final point should be made about the study of learning, memory, and the nervous system. It is not only the cerebral cortex that is involved in learning. In dogs without a cortex[23] and in animals below mammals in which there is no cortex, both learning and memory can be observed to a limited extent. The limitations in memory that are found in lower animals appear to depend in part, at least, on the low level of neural integration and general behavioral organization which exists in these animals. In evolution, memory ability probably is a fair general measure of the degree of integration of action systems within the body.

All studies carried out so far on brain function and memory teach us caution in reaching conclusions about the brain as a learning and memory system. Experiments now in progress promise to revise our theories even further in this field. The observations of Olds and of Delgado, Roberts, and Miller on the neural events related to reinforcement of learning represent another milepost in our understanding of the physiology of learning and of memory.[24] As we learned in Chapter 7, these studies demonstrated that learning and conditioning can occur when electric stimulation of the hypothalamus and other lower brain centers is used as a reinforcing stimulus; that is, direct stimulation of certain thalamic and hypothalamic centers serves to motivate learning. These studies are also important in suggesting the very close relationship which may exist between learning as a physiological change and the integrative mechanisms of emotion and motivation. The future is bright for further advances in the understanding of learning, as a mechanism underlying the acquisition of knowledge and skill, and the adjustment of the individual to the stresses, the barrenness, or the richness of his environment.

SUMMARY

Procedures of training and education are based on the belief that learning transfers from one situation to another. The simplest kind of transfer is from one movement system of the body to another, or from one side of the body to the other.

Positive transfer refers to the facilitation of new learning by old; in negative transfer, previously learned responses interfere with the acquisition of new responses. Transfer effects are not easily predicted. In general, positive transfer is likely when stimuli are similar and the responses are the same, negative transfer, when stimuli are similar and the responses are different. In training for a complex task, positive transfer is more likely if the training situation is very similar to the real-life situation. School subjects transfer very little to general abilities.

The amount of retention depends on the

conditions under which the learned behavior is elicited. Memory can be tested in several forms: memory span, recall, recognition, reconstruction, and relearning. When formerly learned material is relearned, the difference between original learning and relearning measures memory savings.

Retention curves are influenced by the conditions under which retention is measured, the degree of original learning, and the type of material learned. Remembered material often is simplified and lacking in original detail through the reorganizational processes called leveling. These effects and other inaccuracies in memory are important in evaluating fidelity of report.

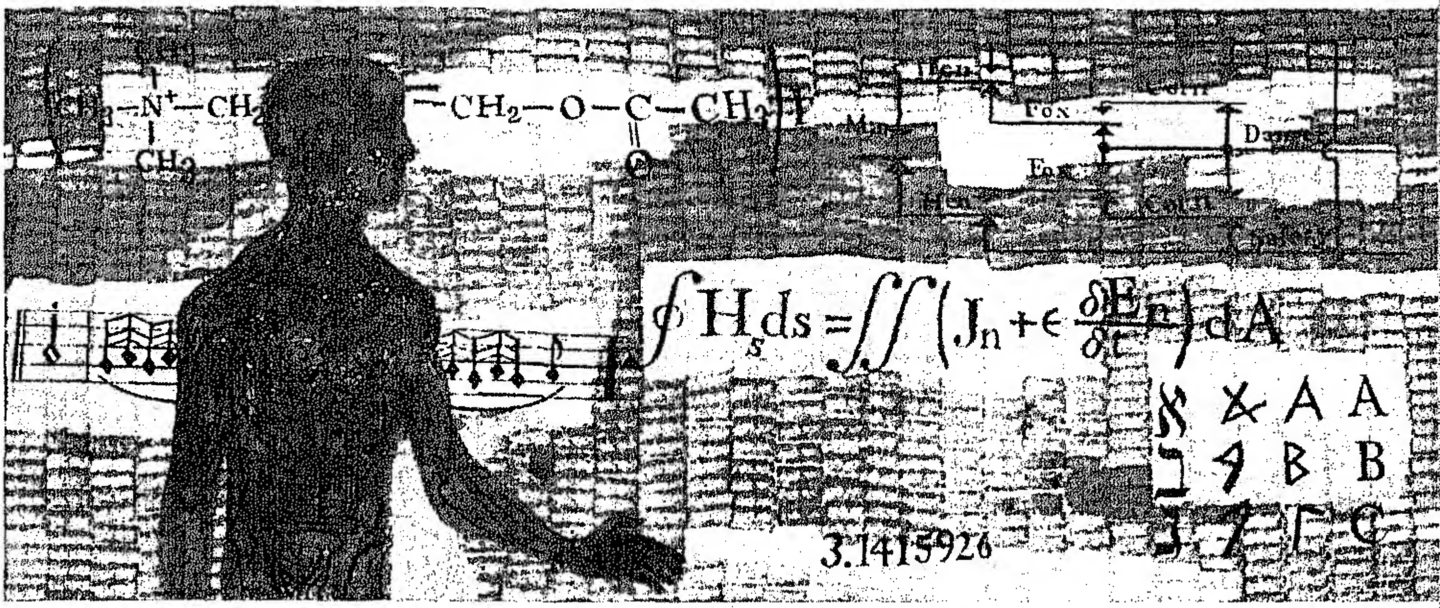
Any factor—particularly the intent to remember, or memory set—which increases the degree of learning also increases retention. Emotional attitudes toward material facilitate retention, with favorable attitudes helping more than unfavorable ones. Our earliest memories are usually emotionally toned. Indifferent material is remembered most poorly.

Retention of learned material is subject to interference by other learning that took place after the original learning. Retention is better when the original learning is followed by a period of relative inactivity. The repression of unpleasant memories can be interpreted in terms of emotional interference.

The most generally accepted theory of forgetting is that it is due to interference. Other factors which have been proposed are time-decay, leveling, and repression.

Memory is more efficient if it is integrated into overall patterns of behavior. We can remember details better in areas in which we already have wide knowledge. Perceptual patterns also facilitate memory.

Most people think of the structural changes accounting for memory as located within the brain. Many neurophysiological studies have indicated, however, that memory and learning are not dependent upon specific neural connections, but upon general integrative changes between organ systems or general functional regions within the brain.



CHAPTER 12. THINKING

Thinking takes many forms in human adjustment. We see it in the logical reasoning of the scientist, the problem solving of a craftsman, and the fantasy of a child. Reasoning, reverie, dreaming, imagination, planning, insight—what do these thought-activities have in common? They are alike in that they all enable the individual to deal with objects and events of the outside world which are no longer present—to deal with the environment in terms of symbols.

Thought is the most private, the very innermost form of human behavior. One evidence of man's versatility is that he can carry through the observable behavior of his daily routine and at the same time live a different life in the private world of thought. An individual's inner and overt activities may be quite unrelated, but when he "hits a snag," when his behavior is blocked by an obstacle, he coordinates his thinking with the problem at hand. Then it serves the very practical purpose of solving problems or relieving frustrations. In such circumstances thinking is a kind of rapid learning, based on symbolic responses.

ORIGINS OF THINKING

The ability to think is not present in the most primitive animal forms, nor is it present in the human child at birth. Our study of the processes of thought leads us to a consideration of the origins and develop-

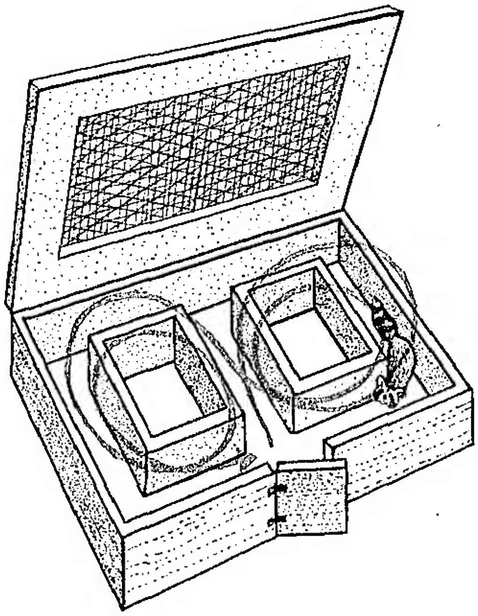


Figure 12.1. A temporal maze. The raccoon is being tested in a double alternation problem. It must go twice to the right and then twice to the left in order to get a reward. (Hunter, W. S. The behavior of raccoons in a double alternation temporal maze. *J. genet. Psychol.*, 1928, **35**, 374–388.)

ment of these processes in their most elementary forms. If we can discover symbolic behavior in animals and young children, it should help us understand the infinitely more complex symbolic activities of the thinking adult.

Symbolic Behavior. We have already been introduced to the development of symbolic behavior in children. In Chapter 5 we learned that one of the simplest tests of an animal's or a child's ability to symbolize an external event in its absence is the delayed reaction, where a signal for a correct response is withdrawn before the response is permitted. Thus an animal which has learned to go to a lighted door to get food is restrained for some time after the light has been turned off. A rat in this situation can respond correctly after a delay of but a few seconds, and then only if it maintains a postural set toward the correct door. Animals higher in the animal scale can delay progressively longer, with no apparent set maintained. Monkeys can delay for several hours under certain conditions. An animal's ability to perform a delayed reaction depends on some symbolic representation within it of the correct response. If this symbolic process in the rat is an observable postural set, can we describe it in other animals as consisting of a symbolic orientation, an *implicit* orientation? We shall return to this problem later.

The other type of symbolic behavior which we introduced in Chapter 5 was alternation behavior. Figure 12.1 shows a temporal maze, in which a raccoon is being tested in a double alternation problem. It is required to run around the block to the right twice and then around the block to the left twice in order to perform correctly. Nothing in the situation gives the animal any cues for the correct sequence of turns, but some sort of symbolic process enables it to make a double alternation. Children tested in this problem can use verbal symbols to direct their behavior—"Two to the right, then two to the left." As we saw in Chapter 5, children cannot learn this response until they are about three years old, an age when their language habits are fairly well developed. Young children do not necessarily use verbal symbols, but may master the procedure as the animals do, by nonverbal means. Monkeys show considerable facility in learning double alternation, and can extend their sequence of correct responses to a dozen or more turns.

Symbolic Generalization. In delayed reaction or double alternation situations, animals deal symbolically with objects and

events not present; that is, they respond correctly on the basis of cues that are within themselves. The thinking processes of man are characterized by the use of *abstract* symbols that stand not for one environmental situation or experience, but for a whole class of events with some common feature. A person who had learned a double alternation problem could symbolize it to himself with the words "double alternation," and if he were told to "perform a double alternation" in a new situation, he could do so immediately, without any learning trials at all. The convenience of language symbols is that one word or phrase can stand for many different objects or events, which vary in some characteristics but are similar in at least one way. "Red" stands for a quality of visual perception that can be abstracted from innumerable objects that are similar in color only.

The problem of whether or not animals are able to use abstract symbols—that is, to "form concepts"—has been studied many times, usually by means of a discrimination learning problem. Figure 12.2 shows a cat which has been trained to choose the black triangle when it is paired with a black circle. After many trials, perhaps as many as 2000, a cat can learn to make this form discrimination as the stimulus cards are shifted back and forth haphazardly. After the learning has taken place, the cat is tested for its ability to generalize its choice to new sets of stimulus pairs, such as those shown in the figure. Usually the animal responds correctly. Most of the test patterns present triangles and circles of different sizes, colors, and so on, but in two cases the correct choice is made on the basis of a "pointed" or "angular" figure as opposed to a circle.

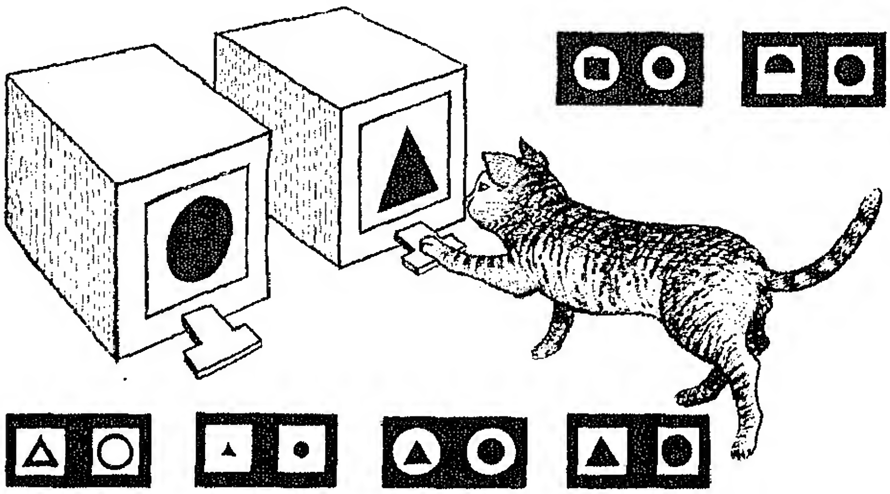


Figure 12.2. Form discrimination in the cat. After many trials, cats were trained to respond to triangles when paired with circles. They also chose other "pointed" or "angular" figures paired with circles. (From Smith, K. U. Visual discrimination in the cat: II. A further study of the capacity of the cat for visual figure discrimination. *J. genet. Psychol.*, 1934, 45, 336–357.)

On the basis of form-discrimination experiments performed with cats, rats, dogs, and monkeys, it has been assumed by a number of experimenters that animals in fact are able to form abstract concepts, such as "triangularity." Results of a recent series of experiments, however, challenge this conclusion. As shown in Figure 12.3*a*, two series of stimulus pairs were used—one set which was completely haphazard so that the arbitrarily chosen correct item of each pair had to be learned by rote, and another set which always presented a triangle in some form as the correct one of the pair. Two groups of monkeys learned these series of discriminations, one group learning the haphazard series and the other the equivalent series. Their performance was compared with groups of four-, six-, and twelve-year-old children and adults. The graphs in Figure 12.3*b* show learning curves for both groups of monkeys and both groups of adults. The monkeys learning the equivalent series progressed no faster than the other group, indicating that they were not able to take advantage of

the fact that the triangle was always the correct response. In contrast, while the adults learning the haphazard series showed a gradually falling error curve for the rote learning, the other group almost immediately abstracted the concept of triangularity as correct, and made no further errors. Four- and six-year-old children trained on the haphazard series learned no faster than the monkeys, but those groups learning the equivalent series, even at these younger age levels, showed some facilitation in their learning.[1] The twelve-year-olds performed almost as well as adults in each case.

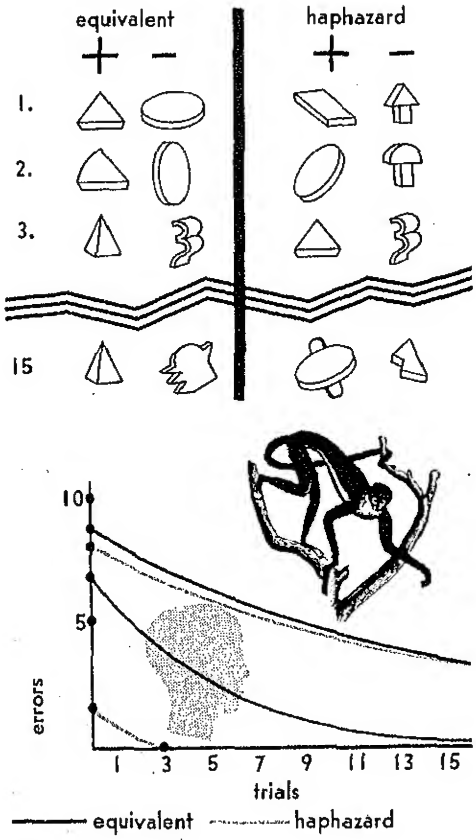


Figure 12.3. Symbolic generalization. Monkeys learned to discriminate the equivalent series, in which the positive stimulus form was always triangular, no faster than the haphazard series. Human adults had to learn the haphazard series by rote, but learned the equivalent series almost immediately. (From Gentry, G., Kaplan, S. J., and Iscoe, I. *Studies in abstractive generalization: comparison between performance of the macaque and the human adult on the same problem.* USAF School of Aviation Medicine Project No. 21-3501-0003, Report No. 12, 1954.)

What accounts for the difference between the ability of the cat to generalize "triangularity" in Figure 12.2 and the inability of the monkeys to abstract the concept in this later experiment? Other studies give us a clue to the answer. When animals have learned to discriminate between a pair of stimuli, they can generalize certain aspects of the stimulus situation to a similar one. Thus if they are presented with a new pair of stimulus objects and required to make a choice, they are likely to choose the one which in some respect is similar to the former correct choice, or to avoid the one which is similar to the former incorrect choice. We have described this kind of behavior before in our discussion of learning, and have called it "stimulus generalization," or "transfer of training." However, animals apparently cannot form a *general concept* which will enable them to take a shortcut in an entirely new learning situation. Monkeys which have learned to choose a triangle from a *pair* of stimuli cannot generalize this learning when they are presented with a large number of stimulus objects on a tray.[2] Children, on the other hand, proceed to pick out all the triangles from the group.

So far, our animal studies lead us to believe that, although animals are able to symbolize objects and events in their absence, and to generalize some aspects of a learned response to a similar problem, they are very limited in their ability—if not unable—to form abstract concepts and apply them to entirely new learning. We have said that thinking is a kind of rapid learning, based on the use of symbolic responses. Animals use symbolic processes to some extent, but are they able to facilitate their learning through the use of symbolism?

Insightful Problem Solving in Animals. We think of symbolic learning as the ability to solve a problem by recombining or integrating formerly learned responses into a new pattern without the necessity of trying out this new response overtly. Thus if we have a map of a large city, we can get from point A to point B in a direct fashion on the basis of our knowledge of map symbols, even though we have never taken this exact route before. Maier tried to test a similar ability in rats, using the maze shown in Figure 12.4. An animal first was permitted to explore the three tables connected by pathways, and then was placed on one of the tables with food and allowed to eat. The third step was to test its ability to combine independent past experiences to solve a problem. The rat was placed on one of the other two tables to see if it would go directly to the table which had held food. Since it had never learned to take this direct pathway for food, the experimenter took its successful performance as evidence of a reasoning ability. A more likely—and simpler—explanation is that the rats had learned habits of general orientation in the experimental room, and thus were able to move directly toward the correct table.

These experiments of Maier are similar in some ways to the classical studies by Köhler on the ability of apes to solve problems by means of "insight."[3] The apes were presented with various problems in which tools had to be used to obtain food. For example, it was necessary to stack boxes on top of one another to reach food hung high off the ground, or to use sticks or hoes to pull in food from outside the cage. What impressed Köhler was the frequency with which an ape would arrive suddenly at a solution to the problem, often when he was not even working at it. It was as if a thinking process had suddenly resulted in an insightful solution.

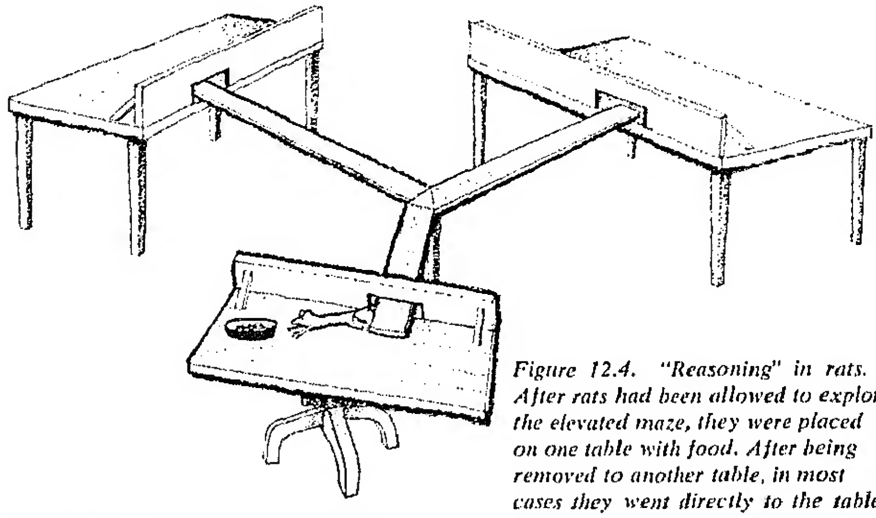
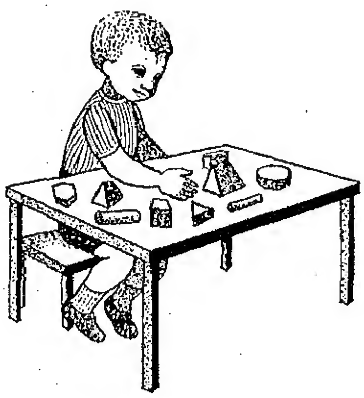


Figure 12.4. "Reasoning" in rats. After rats had been allowed to explore the elevated maze, they were placed on one table with food. After being removed to another table, in most cases they went directly to the table where they had been fed. (From Maier, N. R. F. Cortical destruction of the posterior part of the brain and its effect on reasoning in rats. *J. comp. Neurol.*, 1932, 56, 179–214.)

The critical thing in animal insight seems to be a certain amount of prior learning with respect to the components of the problem. Apes showed no insight into the proper use of hoes unless they had been allowed to use hoes previously. Harlow has found that monkeys and children show progressively faster learning in problem solving, the more problems they have solved in the past.[4] In other words, the ability to solve problems quickly, to show insight, is an ability that can be learned.

Criteria of the Thinking Process. Our descriptions of the subhuman precursors of thought help us to understand a little more clearly the nature of thinking in human individuals. We have seen that thought requires the use of symbolic behavior. Animals can symbolize one concrete event and direct their behavior by this symbolic process, as when they respond to the doorway which is no longer lighted. Children, in

Figure 12.5. Thinking as a process of abstractive integration. The child has abstracted the concept of the triangle and has generalized a two-choice discrimination to an entirely new situation.



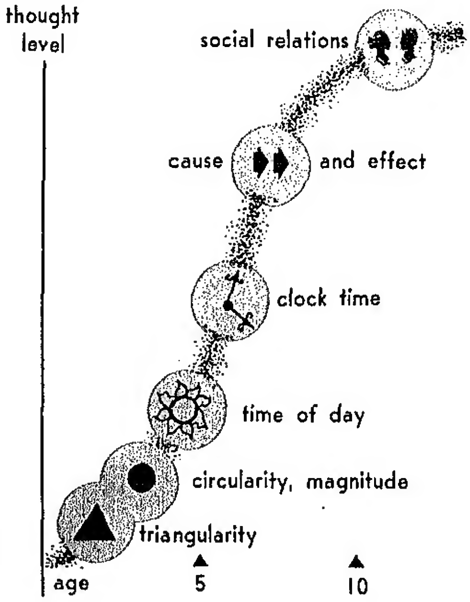
contrast, can symbolize a whole series of events in terms of one concept—for example, triangularity. Thus human thinking involves the use of *abstract* symbols, the first criterion of thought.

The second critical aspect of the thinking process is the ability to integrate past experiences to solve new problems without overt trial and error. Monkeys and apes show this integrative ability to some extent, as we have seen, but they apparently can deal with objects and situations in "insightful" ways only if they have had concrete experiences with them. The human individual is not limited in this respect. We are sure that thinking is occurring if an individual can integrate the abstract symbols of his past experiences and so shortcut the learning process. Thus we might say that thinking is the process of *abstractive integration.* The child in Figure 12.5 who is choosing all the triangular forms on the table is displaying the critical characteristics of thought. He has abstracted the concept of the triangle from his previous learning experiences, and has generalized the response learned in a two-choice discrimination to an entirely new choice situation.

We cannot say with certainty that the higher subhuman animals meet these criteria of true thinking. They clearly show some rudimentary forms of symbolism and integrative learning, but whether we say that animals can think is to some extent a matter of definition. The significant point is that a human child, by the time he is three or four years old, is outdistancing monkeys and apes.

Development of Thinking in the Individual. We cannot pinpoint the origins of thought in the child with any more success

Figure 12.6. The appearance of common concepts in children. Spatial concepts typically develop first, followed by temporal and abstract concepts. (Based on Vinacke, W. E. The investigation of concept formation. *Psychol. Bull.*, 1951, **48**, 1–31.)



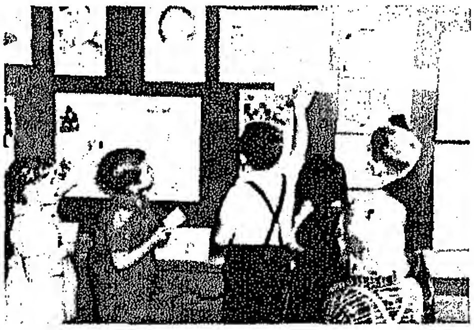
than we could in animal behavior. One of the first psychologists to study this problem, Piaget, described a child's thinking as egocentric—that is, making few distinctions between himself and his environment.[5] By the age of seven or eight, according to Piaget, the child begins to think logically, in terms of concrete perceptual experiences, and understands cause-and-effect relationships. Only later does he learn the formal types of thinking of the adult, as shown by the ability to deal with symbols in abstract ways. (What we have called abstractive generalization of triangularity, above, would be in Piaget's terms concrete thinking based on perceptual experiences.) Other investigations of children's thinking have concluded that Pia-

get's seven- to eight-year age level is too high, that systematized cause-and-effect thinking typically appears in younger children.

Another description of the development of thinking, as shown in Figure 12.6, is in terms of the appearance of some common concepts. Perceptual concepts, related to geometric form and magnitude, appear quite early, around three years; concepts of time, around five to seven years; while more abstract concepts appear around eight to twelve years. As one might expect, children vary considerably in these respects.

Thinking develops more slowly than any other aspect of behavior. We can trace its evolution in the individual through the following five stages: (1) prelingual, (2) symbolic, (3) concrete, (4) relational, and (5) creative. Up until the time he learns to talk, a child is in the prelingual stage and probably cannot carry out true thinking activities as we have defined them. The symbolic stage appears with the development of language, involving at first simple symbolic behavior. Figure 12.7*a* shows how the use of symbolic behavior is encouraged and facilitated in school children.

Concrete thought (Figs. 12.7*b* and *c*)—that is, the manipulation of symbols of classes of perceptual events—probably starts as early as three years. Now the child has a longer memory for events and becomes more skilled in manipulating and testing his ideas. He understands simple principles of causation. Relational thinking goes beyond concrete thinking to an appreciation of interactions among events and abstract concepts (Fig. 12.7*d*). Such thought is essential to all higher forms of symbolic behavior, particularly in mathematics and logical thought.



a

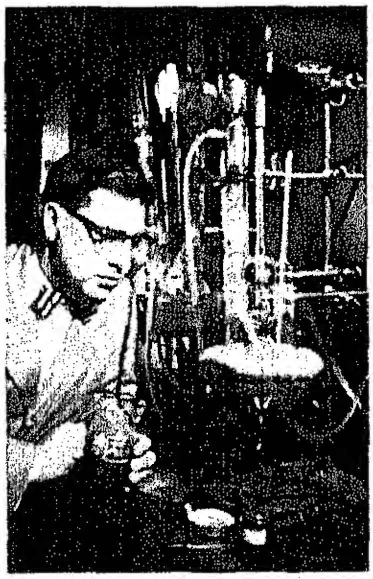
b

c

d

Figure 12.7. Stages in the development of thought. a. *Development of symbolic behavior in school children.* b *and* c. *Concrete thinking.* d. *Relational thinking.* e. *Creative thinking.* (*a-d*, courtesy Board of Education, Madison, Wis.; *e*, courtesy Johnson's Wax.)

e



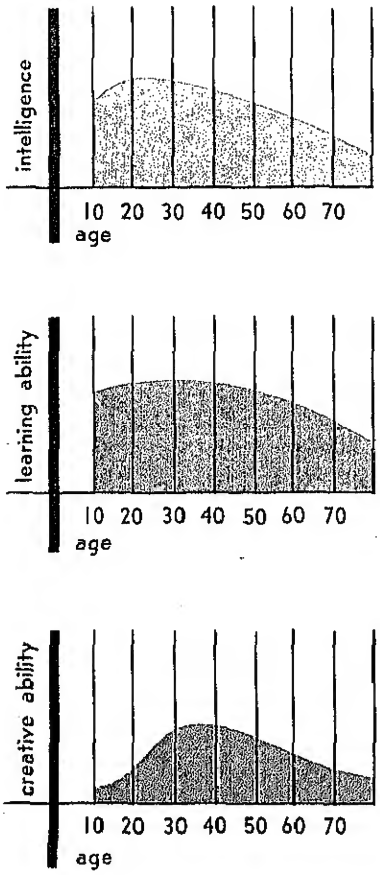


Figure 12.8. The general growth and decline of intelligence (as measured by test performance), learning ability, and creativity. Creative ability, like learning ability, typically reaches its maximum level around 30 to 40 years of age. (Miles, C. C., and Miles, W. R. The correlation of intelligence scores and chronological age from early to late maturity. *Amer. J. Psychol.*, 1932, **44**, 44–78; Miles, W. R. Abilities of older men. *Personnel J.*, 1933, **11**, 352–357; Lehman, H. C. "Intellectual" versus "physical" peak performance: the age factor. *Sci. Monthly*, 1945, **61**, 127–137.)

Relational thinking enables a child to represent to himself the interplay between people, and to recognize that the same person or event changes its nature under different conditions. Thus mother is a different person when she has guests than when she is alone with the family. Relational thinking may start as young as seven or eight in a bright child, and probably occurs by the age of twelve in most children.

The highest level of thought—original creativity (Fig. 12.7*e*)—usually appears in the early teens, reaches a peak of efficiency in middle life, and thereafter declines. The curves in Figure 12.8 compare the general patterns of growth and decline of intelligence, learning ability, and creativity. As measured by our comprehensive, standard intelligence tests, intelligent performance reaches a peak in the twenties and drops off gradually thereafter. Tests showing this early peak are usually those incorporating a speed factor. Learning ability, as measured by an alphabet-substitution task, reaches a peak somewhat later, around forty. The third curve shows that the growth and decline of creativity is more like that of learning ability than that of intelligence. The creative production of outstanding men usually reaches a maximum in the late twenties or early thirties. Poets have their best years in their twenties, but mathematicians and scientists usually do best in their thirties. Outstanding performance in mathematics and chess playing can continue at about the same level until the age of sixty.

Concept Formation. We have already learned something about the development of concepts from the studies of abstractive generalization in monkeys and people, but let us define more clearly just what we mean by a concept. It is not just a word, although we use words to identify many of our concepts. A concept is the symbolic representation we make of the common characteristics of a whole class of objects, people, or events. In our ordinary speaking and thinking, we use innumerable concepts —dog, fruit, woman, liberal, justice, and so on. Some of our concepts refer to complex relationships which have no objective reality.

Concepts develop through learning—either the relatively slower learning of concrete experiences or the rapid learning that can occur in thought. In each case, the ability to form concepts depends on responding both to similarities and differences among objects, events, or relations. A child develops his concept of a dog by responding to similarities among dogs, but if he is to use this concept correctly—that is, as other people use it—he must learn to respond to the differences between dogs and cats, horses, or rabbits. These features of learning are at the basis of what we ordinarily call induction and deduction. From a sequence of specific instances we generalize a common element by induction. Then by deduction we apply our concept to a new event. If our deduction doesn't work, we are forced to differentiate this particular event from previous ones, and so refine our concept. Our facility in dealing with concepts depends on the breadth of our experience and training in their use.

We can study concept formation indirectly by observing the appearance of concepts in children, or directly by controlled experimental situations. We find some interesting parallels between the development of concepts in laboratory experiments and real-life situations. Figure 12.9 shows a subject seated before a memory drum, in

the process of learning concept names for the objects presented visually on the drum. When the two rabbits are exposed, the experimenter tells the subject it is a "ling." A large number of different objects are shown, which are called "lings," "fards," or "relks." Some of these are shown in the figure. The subject obviously can call out the correct names of the stimulus objects more readily if he discovers the common property among the members of a class, or "forms a concept." Can you name the objects shown in Figure 12.9? In experiments such as these, object concepts usually are evolved first, then spatial ones, and finally numerical concepts.[6] In Figure 12.9, the concept of "ling," or "twoness," probably would be the last to be learned. It will be remembered that the development of concepts in children follows the same general pattern.

Although language is very important in learning to apply concepts, it can be shown that concepts can be formed and used without being verbalized. One experiment used a set of sixteen blocks of different sizes, shapes, colors, thicknesses, and other varying characteristics, which a subject was asked to sort into four groups.[7] The experimenter had a prearranged plan for the "correct" sorting, and informed the subject when he was right and wrong. Sometimes the subject could sort the blocks successfully without being able to put into words what system he had used. Another study using these same materials found that attempts at verbalization frequently interfered with efficient performance.[8] It seems clear that an individual can develop, test, and use concepts without being aware of the specific stimulus properties or the principle upon which his behavior depends. We should remember this aspect of concept formation when we study the related problems of attitudes and beliefs.

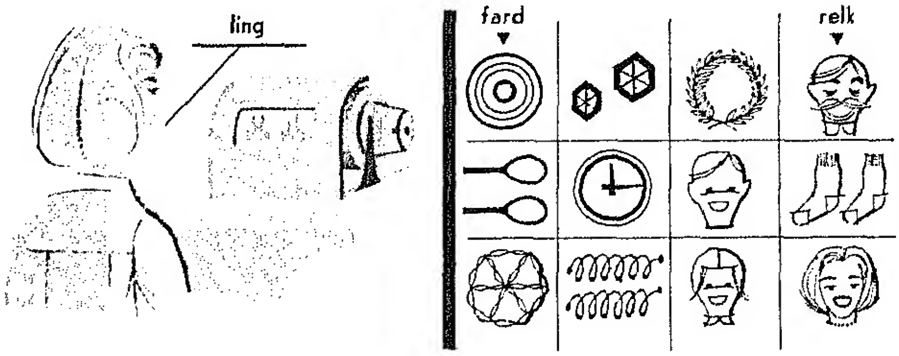


Figure 12.9. Concept formation. The subject must learn to identify the stimulus objects as "lings," "fards," or "relks." The concept of "ling" (twoness) typically develops after the others. (From Heidbreder, E. The attainment of concepts. *J. gen. Psychol.*, 1946, 35, 173–189; 191–223.)

Evolution of Thought in Society. In the emergence of man as a thinking animal from his subhuman ancestors, the activities of thought did not arise suddenly, full-fledged, as from genetic mutation. Rather, they evolved gradually as an extension and refinement of already existing modes of behavior. At all levels of human endeavor, thought and action are inseparably related. Notions of cause and effect with respect to natural processes, disease and death, reproduction, and social interplay have always been a part of very practical efforts to control these processes. The magic rites of primitive societies are not pure nonsense, but represent the adjustive applications of the limited knowledge and action available to primitive man in the face of the stresses and terrors of his environment.

The development of man's ability to think is both a product and a cause of the concurrent refinement of his special systems of symbolization and language. Gestural movements, then spoken language, were the first sharp "tools" of thinking. Later, the technique of writing provided a critical refinement of thought by making

permanent the products of man's thought, his knowledge, and his beliefs. Written language frees the thinker to some extent from the speakers and the social pressures around him, enabling him to progress into the abstractions of logical reasoning. The most recent innovation in human thought, scientific reasoning, is based on logic, written records and graphs, and precise, instrumental observations. Like all other forms of thinking, scientific reasoning has become an essential aspect of all of our adjustments. We eat, drink, raise families, and destroy enemies through its use. The behavior of man is inextricably tied up with his thinking behavior.

THE NATURE OF THE THINKING PROCESS

Our brief examination of the origins of thought in animals, in the human individual, and in the race points up a fundamental conclusion about its nature. We find no sharp break between nonthinking and thinking, but rather a continuity in which gross, overt, nonsymbolic patterns of behavior gradually evolve into the precise, abstract refinements of creative thought. Thinking activities are among the most difficult of human activities to study. Perhaps the greatest significance of the developmental studies is the insight they provide us into the nature of thinking in adult man.

Prior to the emphasis on behavioristic psychology, thinking was assumed to be an activity of the mind, entirely divorced from the activities of the body. For those who believed in a mind-body dualism, mental activities were not even thought to be physical in nature. As scientific psychology increasingly emphasized the bodily basis of all man's activities, thought processes were assumed to go on within the brain. This idea is known as the central theory of thinking, and is still held by many psychologists today. The first person to propose a serious alternative to this view was the behaviorist, Watson, who maintained that thinking consists of subvocal speech—that is, implicit movements of the speech mechanism. This view has proved to be too limited, but it opened the way to a new kind of controlled observation of the thinking process.

Implicit Muscle Movements. If thinking involves implicit muscular responses, however small, we ought to be able to record such movements by electrophysiological techniques. The first recordings of this sort were obtained with subjects who had been trained in progressive relaxation, so that they could lie relaxed, with a minimum of muscular activity. Electrodes were attached to various parts of the subjects' bodies to record very small muscular responses. Lying relaxed in a darkened room, subjects were told to think of various activities. If, for example, a subject thought of striking two blows with a hammer, the resulting record of activity in the arm muscles showed two sharp bursts, as shown in Figure 12.10. Similar muscular responses could be recorded when the subject thought of bending his arm, throwing a ball, and the like. When he thought of looking at the Eiffel Tower, activity in the neck muscles could be detected. These experiments demonstrated that not just speech movements, as Watson had suggested, but implicit muscle movements from all parts of the body can accompany thinking. However, it is believed that subvocal speech plays a very important part in thinking, since so much of our symbolic activity is

in terms of language symbols. In fact, recordings of implicit movements of the lips, tongue, and throat during thinking have been obtained.

If implicit speech is so important, how is it that nonspeaking deaf persons carry on thinking? If a person talks with his hands, does he also use his hands to think? Recordings of the implicit activities of the hands and fingers in deaf persons showed that this may be the case.[9] When deaf subjects were compared with normal subjects in performing abstract problems such as "mental arithmetic," the incidence and amplitude of electric activity in the hands and fingers of the deaf were much greater than for speaking subjects. Differences were also found in these manual activities during sleeping and dreaming. Recordings were made from the hands while the deaf subjects slept, and when a burst of activity occurred, they were immediately awakened. In 30 out of 33 cases, the subjects reported that they had been dreaming. If they were awakened while their hands were quiescent, they rarely reported dreaming activity.

The behavioral aspect of thought is more dramatically demonstrated in one of the skills of "mind reading," which might more properly be called "muscle reading." Not long ago a well-known entertainer claimed that he could find a certain key hidden anywhere on Manhattan Island, providing that he be accompanied by a person who knew the key's location and that they be in contact by a handkerchief held between them. In a relatively short time the muscle reader located the key in a basement room of the Empire State Building, although his "guide" was not aware of the fact that he was providing clues. This person revealed his thoughts by subtle movements which the entertainer had taught himself to detect.

Suggestion and Hypnosis. The phenomena of suggestion and hypnosis show very clearly that thinking occurs in relation to behavioral processes of the body. When we say that some people are more "suggestible" than others, what we mean is that thinking and symbolic behavior in some people involve more observable bodily adjustments than in others. If a person is told to imagine that he is falling backward but to remain perfectly upright, some degree of body sway can be detected. A very suggestible individual will, if not caught, literally fall down. When a person is told to put his finger in water which is "ice cold," the blood supply to the finger is reduced, even though the water is not actually cold.

Extreme conditions of suggestibility can be observed in an individual who has been hypnotized. Although hypnotism has been the subject of a great deal of mysticism and quackery, it is a valid psychological phenomenon, closely related to other forms of suggestion and thinking. Hypnotism has been used to some extent in psychotherapy,

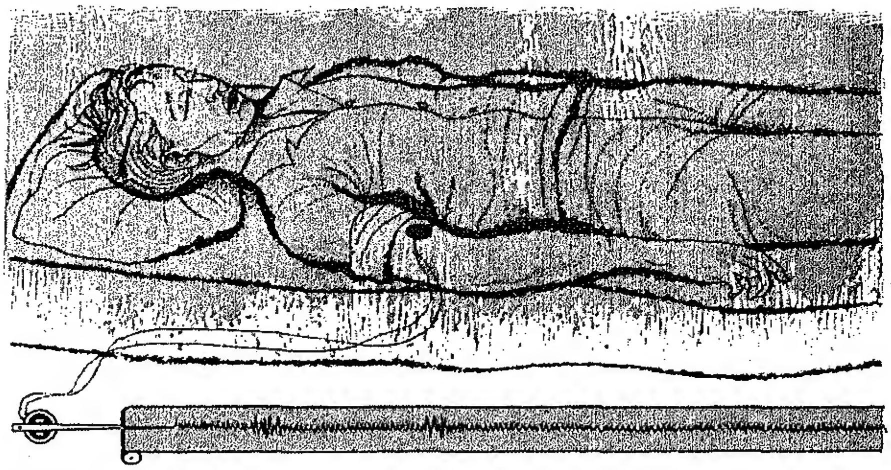


Figure 12.10. Implicit movements in thinking. When the subject was told to think of striking two sharp blows with a hammer, two bursts of activity appeared on the recording of muscular activity of the arm. (From Jacobson, E. Electrophysiology of mental activities. *Amer. J. Psychol.*, 1932, 44, 677–694.)

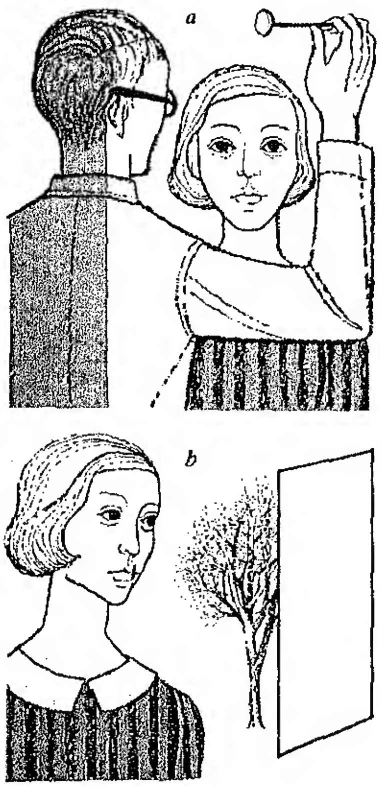


Figure 12.11. Suggestion in hypnosis. a. *The hypnotic trance is induced by a series of suggestions from the operator, supported by techniques which contribute to fatigue and eye strain.* b. *Posthypnotic suggestion. While hypnotized, the subject was told she would see a tree on a blank card, and later describes the tree in detail.*

and under certain circumstances can be employed as a substitute for anesthesia in dentistry, childbirth, and surgery. Some hypnotized persons feel no pain if given appropriate suggestions.

The trancelike state of hypnosis is produced ordinarily by a series of suggestions of the operator to the subject that he will cooperate, that he is tired, sleepy, wants to go to sleep, and so on. As shown in Figure 12.11*a*, these suggestions are often aided by props of one sort or another to increase the operator's effectiveness. If the subject is told to look at a shiny object held just above eye-level, his eyes and neck muscles begin to get tired, an effect which enhances the operator's verbal suggestions. If the subject becomes hypnotized, he is very suggestible to everything the operator tells him to do. One of the most remarkable effects is that of *posthypnotic suggestion*. While in the trance, the subject is told that he will do a certain thing at a certain time after he is awakened. This suggestion will be carried out, even though it may appear quite ridiculous. The subject in Figure 12.11*b* has been told that she will see a tree on a card after she wakes up. Some time after awakening she describes "the tree" in considerable detail. As a general rule, hypnotized persons do not follow suggestions that are not in keeping with their social values and moral code. Thus a person probably would not commit a crime under hypnosis, unless he were capable of such an act at other times.

Some people make better hypnotic subjects than others, although we do not know exactly what accounts for the differences among individuals. Young children and intellectually retarded persons usually cannot be hypnotized. Among adults, good subjects are as likely to be found among the highly intelligent as among people of ordinary intelligence.

There have been many attempts to use hypnotic procedures in order to break undesirable habits such as smoking, to facilitate learning, perception, or memory, even to alter one's personality. The evidence at this time does not permit any definitive conclusions regarding the effectiveness of these methods. The experimental study of hypnosis is only just beginning. Any objective information we can obtain about the factors involved in hypnotic suggestibility should further our understanding of the processes of thought.

The Peripheral Theory of Thought. All of the evidence concerning bodily activity and thought, including the little we know about hypnosis, has given rise to the theory that thought is, in fact, a pattern of sensorimotor behavior, not essentially different from any other kind of behavior. This view contrasts with the *central theory*, mentioned before, which assumes that thinking is a function of the brain alone. Those who believe thought to be a central or brain process hold that the implicit muscle movements we have described may accompany thought, but are not essential to thinking.

We have diagrammed these two theories in Figure 12.12. The central theory represents thinking as consisting of integrated neural activities within the brain. These activities may be initiated and influenced by sensory stimulation, and eventually they may lead to motor response, but the thought itself is central. The peripheral theory makes use of what we know about sensory feedback mechanisms to explain the nature of the thinking process. Here the brain serves as a central connecting and inte-

grating system, but equally important are the activities of the receptors and effectors. Sensory feedback from responding effectors of the body makes possible the continuous, high-speed processes that characterize thinking.

Although at the present time we cannot put these hypotheses to a final and conclusive test, the peripheral theory seems to be a reasonable way of describing what we know about thinking. Perhaps the most significant aspect of this theory is its emphasis on the fundamental unity of all kinds of behavior. Our developmental studies show that thinking evolves gradually out of the larger patterns of response. According to the peripheral theory, this evolution involves a gradual change in degree of activity, rather than a change in kind.

Parapsychology. Many individuals, including some psychologists, feel that there are events in human thought that cannot be explained by physical laws. The coincidence of thoughts of two people at a distance, presentiments of future events, as in dreams, the ability to forecast the fall of dice or cards with what appears to be more than chance accuracy—these occurrences are considered by some to be beyond the range of normal behavioral laws. A group of psychologists has attempted to study such phenomena as events of "extrasensory perception" (ESP): perceptions and thoughts initiated by other than sensory means. We call these investigations "parapsychology," because they deal with paranormal events—that is, events described in nonphysical terms. Recently, the parapsychologists have extended their interests into the field of animal migration, particularly the migration of birds, which they feel is so mysterious as to require the postulation of extrasensory or telepathic powers.

The primary experiments of parapsychology have been concerned with the extrasensory abilities of certain individuals to call the markings of a deck of cards without being able to see them, or to influence the fall of dice. In general, these experiments have failed to convince most students of behavior that any supernormal powers have been discovered. We might also note that serious students of bird migration believe that birds orient their migratory flights according to their perceptions of the location of the sun.[10]

MOTIVATION IN THINKING

Human thought varies from the emotional dreams and fantasies of the disturbed personality, through the tense predictions of the gambler or stock market operator, to the rational calculations of the practiced scientist or mathematician. It may deal with observable realities, the abstractions of number systems, or the events of the atomic world far beyond the limits of direct perception. At first glance, these extremes may seem hard to reconcile as examples of the same kind of activity. However, the activities of thought are no more varied than are other aspects of human behavior. We can bring some order into its diversity by observing how thinking follows the same well-established laws that govern all behavior.

We have learned that some of the principal characteristics of behavior are that it is motivated, that it is organized according to the perceptual-social environment, and that it changes according to the experience of the individual. Let us see how these same factors determine the nature and course of thinking.

Figure 12.12. The central and peripheral theories of thought. According to the central theory, thinking goes on within the brain. The peripheral theory assumes that thinking is similar to other forms of behavior, consisting of a series of stimulus-response sequences.

Reverie, Fantasy, and Dreaming. We often hear the expression, "My mind was a blank," but it rarely applies to the waking individual. We usually are thinking of something, however inconsequential. Since much of the routine of our daily existence does not occupy our whole attention, we can simultaneously engage in thinking about other things. If nothing is bothering us at the moment, and if nothing interferes with our routine tasks, our thinking may be relatively "uncontrolled," jumping from one topic to another in a seemingly haphazard sequence. Yet no behavior is really haphazard, but is directed by external and internal stimuli acting on an organism of a particular make-up.

Our so-called uncontrolled reverie is actually at the mercy of both external and internal control. A voice, a striking clock, the sound of a plane, may start an entirely new train of thought. Unnoticed external stimuli may arouse a long series of associated memories. For example, a faint, unnoticed odor often calls to mind long-forgotten episodes from the past. Sometimes a memory comes to us with striking clarity "out of the blue," but if we stop to analyze the situation, we often can identify the external stimulus with which the remembered event was associated. Even our dreams can be organized around an incidental noise in the night.

More typically, our dreams and waking fantasies are directed and colored by our emotional needs and goals. Just as overt behavior is organized by the individual's patterns of motivation, so are the activities of thought. Thinking which is controlled almost exclusively by needs and emotions with little reference to the events of the outside world is called *autistic* thinking. Many of the frustration reactions described in Chapter 3 are kinds of autistic thinking motivated by the anxieties aroused by blocking and conflict. The substitute reactions of frustration are not directed toward solving basic problems, but serve the purpose of relieving anxiety and reducing tension. Thus frustration dreams and fantasies need not conform to the outside world, but only to the inner world of emotional desires.

The content of dreams is notoriously bizarre and illogical, rarely showing the meaningful continuity of waking thought. According to the psychoanalytical point of view, a dream is fantastic and illogical only superficially—in its manifest content, which expresses symbolically the important emotional needs and conflicts of the dreamer (see p. 66f.) This symbolic interpretation of dreams is probably true to some extent, for similar forms of symbolism can be observed in many kinds of waking behavior. The pun or *double entendre* joke is usually appreciated because of its inherent symbolism. The creative artist or writer enriches his work with symbolic expressions of man's most cherished hopes and beliefs. Normal individuals recognize the differences between the events of fantasy or dreams and the observable realities of the world about them. When a person fails to distinguish between them, we say that he is "losing touch with reality," and fear for his psychological health.

Problem Solving. More common than fantasy for most of us is the more practical kind of thought that is motivated by a problem situation. Whenever we are momentarily "stumped," we coordinate our thinking with overt action in trying to find the solution to our problem. It may be that

we have lost something, and try to figure out how to find it. Or, perhaps something breaks and we want to fix it. Even planning our work for the day is an attempt to solve the problem of getting the most important tasks done in the most efficient manner. Problem solving often has much in common with the trial-and-error learning we spoke of in Chapter 10, but the ability to think makes the whole procedure faster. A solution that can be tried out symbolically does not require as much time and effort as overt trial. Still, our problem solving is often a coordinated activity involving both the symbolism of thought and overt trials and errors. When we try to fix something, we work with our hands while we are trying to understand what has to be done.

Experiments on problem solving reveal some of the methods people use to reach a solution, as well as the behavior they may resort to when they fail. Consider the problem situation in Figure 12.13. The girl has been asked to tie together the two strings hanging from the ceiling. She can reach only one of them at a time. There is one "correct" solution to this problem, for which the only tool or aid needed is the pair of pliers lying on the table. Of 61 subjects who were given the problem, only 24 solved it within ten minutes. Now suppose the experimenter brushes one of the strings as he walks by, causing it to swing slightly, and at the same time says, "You can solve the problem in only one way, and that way requires your using the pliers." Now is the solution clear? Among the 37 remaining subjects who were given these two hints, 23 solved the problem, while 14 never did solve it. The solution depended upon perceiving a relationship between the pliers and the string. A subtle change in the perceptual field brought about by the slightly swinging string made it easier for the subjects to see the string as a swinging pendulum with a weight on the end.

Just as interesting to us as the factors leading to success in this problem are the reactions of failure. Subjects who did poorly did not vary their attack as frequently as did the successful subjects. This is a not uncommon observation in problem situations, that some individuals repeatedly try a method that fails. These are the stereotyped reactions or fixated responses of frustrated individuals (see Chap. 3). When a problem or conflict leads to frustration, an individual may resort again and again to a line of attack repeatedly shown to be wrong.

We often observe these persisting, sometimes fixated characteristics of thinking in students faced with difficult emotional problems which they have not been able to resolve. Sometimes a student will go through college carrying with him individual habits of thought which actually act as a barrier to a solution of his problems. These fixated ideas may be related to particular courses of study. For example, a student's belief that he can not do statistics may be based more on past frustration than present inability.

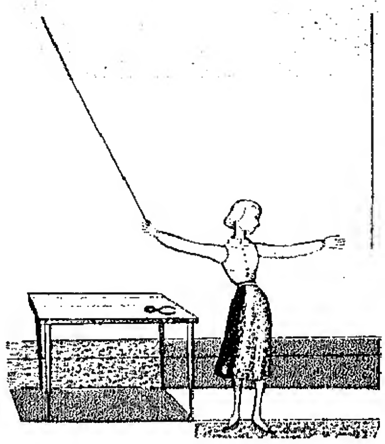


Figure 12.13. The two-string problem. In order to solve the problem of tying the two strings together, subjects had to tie the pliers to one string and swing it like a pendulum. (From Maier, N. R. F. Reasoning in humans: II. The solution of a problem and its appearance in consciousness. *J. comp. Psychol.*, 1931, **12,** 181–194.)

Habits in Thought. In a problem situation, the nature of the solutions which suggest themselves depends on the past experience of the individual. Thus if he has faced a similar problem in the past, he is inclined to try a solution which has been successful. In most cases our remembered experiences and knowledge are helpful in new situations, but in some cases an established habit or thinking "set" can prove

to be a hindrance. In the experiment described in Figure 12.13, the pliers probably did not present themselves to most of the subjects as a "weight," because they were perceived as a tool.

It has been found experimentally that when an object is used in one way in one situation, using it differently in a subsequent problem is made more difficult.[11] This inability to shift object functions in problem solving has been called "functional fixedness."[12] When subjects were first required to use either a relay or a switch in constructing an electric circuit, and then were presented one minute later with the problem of the hanging strings with these objects among others as possible weights, approximately 70 percent did not make use of either the relay or the switch. Other subjects who were given these two problems one week apart were not handicapped in the same way. In a week's time they had lost most of their specific "set" toward the objects.

In another experiment on the effect of a predetermined set, subjects were given a series of problems like the following:

> Assume you have three empty jars as measures, which contain exactly 14, 163, and 25 units respectively. How would you use these measures to obtain exactly 99 units of water?[13]

The solution is, of course, to fill the second measure, then to fill from it the first measure once and the third measure twice. The water remaining would be 99 units. Several more such problems were given, all of them solvable in exactly the same way. Finally, the subjects were tested on a problem in which the empty measures were 23, 49, and 3 units, to be used to obtain 20 units of water. Everyone solved it through the method he had been using, not noticing the faster, easier solution. Several subjects who were instructed to write the words, "Don't be blind," just before the test problem noticed the easy solution.

The thinking sets which we have described were relatively transient, and could be easily changed once the advantage of such change was perceived by the subject. In other words, the subjects were not motivated to continue the sets that had been established. We find an entirely different situation, however, with regard to the relatively permanent thinking sets which make up what we call attitudes. Much of human thinking is guided by firmly entrenched attitudinal habits that are based on the emotions, frustrations, needs, and desires of the individual. Our attitudes may not be logical, or efficient, or valid, but they satisfy an emotional need and are not easily changed. Many experiments have shown how attitudes, or emotionally based thinking habits, can distort the course of problem solving and reasoning. As an example, one experiment has demonstrated that subjects from southern states showed more distortions of reasoning—that is, reached more invalid conclusions—on material involving the status and behavior of Negroes than did subjects from northern states.[14]

Insight. Highly original, creative thinkers are less bound by preconceived notions and habits than other individuals. To the creative thinker, the experience we often call "insight" comes more easily because he is able to reorganize his past experiences and knowledge into new and original patterns. In the experiment of the hanging strings it takes a certain amount of originality to be able to "see" the pliers as a weight, but once this reorganization

takes place, the solution is at hand, and *the "learning" period is over.*

The first emphasis on insight as a means of problem solving developed among the gestalt psychologists. Köhler's descriptions of insightful learning in apes have already been mentioned. The gestalt view is that insight goes beyond the processes of routine learning, and comes about as a result of a sudden reorganization of the psychological field. To illustrate the nature of an insightful solution, consider the problem in Figure 12.14. Can you arrange the six matches in such a way as to form four triangles of the same size? Naïve subjects are usually hampered in attacking this problem by the notion that they must work in two dimensions. Their trial-and-error procedures lead nowhere and they quickly become baffled. However, if it becomes apparent that it is possible to make a three-dimensional model of a pyramid, the problem is immediately solved. In gestalt terms, this insight requires a realization of the "inner structure" of the problem, and involves a perceptual restructuring of the field with an equivalent reorganization occurring in the cortical centers of the brain. Gestalt psychologists deplore the "blind, senseless" methods of teaching by rote, and emphasize the importance of structuring the problem situation so that the spontaneous reorganizations of insight can occur.

We already have indicated in our discussion of insight in animals an alternative way of understanding the process. An insightful solution to a problem is sudden, and it involves a reorganization of responses, but it is based on sufficient prior learning to make insight possible. Köhler's apes used sticks and tools in insightful ways only if they had had experience in manipulating these objects. Thus a perceptual or *psychological reorganization of the field* does not necessarily occur spontaneously, but depends on the utilization of previously learned responses. The great advantage of the thinking individual is his flexibility in adapting his knowledge to the demands of new problems.

There are many accounts which have been written by famous artists and scientists describing their own thought processes in relation to insight and creative activity. They invariably emphasize the necessity of securing knowledge and information as the first step in solving original problems, or in achieving insights. The following *general description* has been given of the stages of creative thought: (1) preparation, (2) incubation, (3) inspiration, and (4) verification. The first stage, that of preparation, may go on for many years. An original thinker prepares for the discoveries of his adult years throughout all his years of schooling and advanced training. The moment of insight may appear to be a shortcut, but there is no shortcut which by-passes the necessary learning of stage 1. The stage of incubation is less easily defined. According to the people who have used this description, it represents a period of little progress toward solution, when the thinker may, in fact, turn his attention to other things. The moment of "inspiration," or insight, may come quite suddenly, often during the course of unrelated activities. It is as if too strong a motivation to achieve solution of a problem hinders rather than helps the thinker, by arousing within him the inefficient reactions of frustration. When he turns away, the emotional disturbance dissipates, and an original solution is made possible.

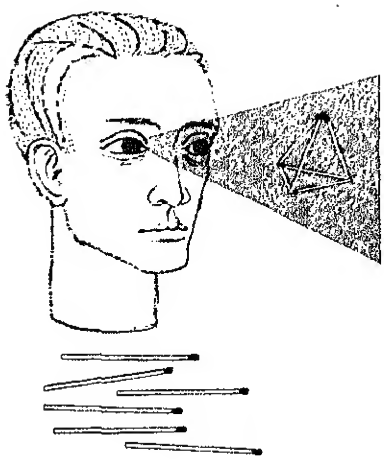


Figure 12.14. Insightful solution of the six-match problem. Given the problem of arranging six matches to form four equal triangles, most people try to work in two dimensions. The idea of forming a three-dimensional pyramid comes as a sudden insightful reorganization.

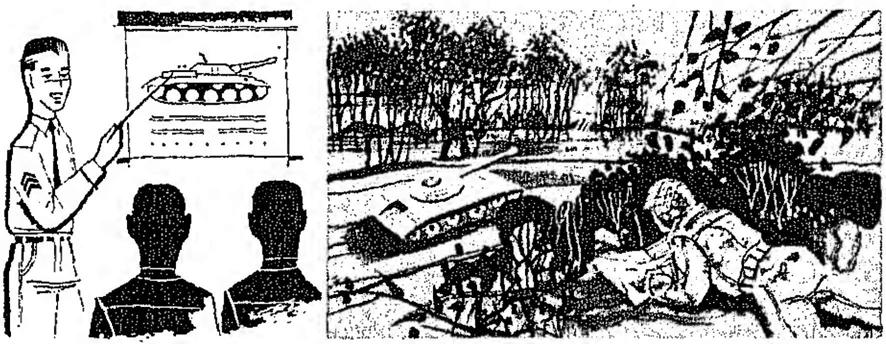


Figure 12.15. Stages in original thinking. Creative thinking depends upon prior preparatory learning. If the problems dealt with are practical or experimental, the solutions must be verified objectively.

The fourth and last stage in creative thinking is that of verification—determining whether the solution will "work." If the problem is a practical one or a scientific experiment, verification must be in terms of the manipulation of objective events. We can use the soldier in Figure 12.15 as an example of the stages in original thinking. His preparatory stage has included a long period of training, in which he was taught a great deal about battle tactics and received specific symbolic training in the use of maps and so forth. Now he has an actual problem in a real or simulated battle, and brings to bear all his knowledge and learned symbolic habits toward achieving a rapid solution. His solution is immediately tested or verified in terms of the actual events of the battle.

In many cases it is impractical or impossible to test our thinking objectively, and in such cases we rely on its internal consistencies for verification. Some of our symbol systems are so rigidly structured that when they are used according to rule their validity is not questioned. The basic procedures of mathematics need not be checked against objective criteria each time they are used; we all know that $2+2=4$ without counting apples or eggs. Although most of our thinking is not as precise as mathematics, our rules of logic have been developed to make it as accurate as possible.

Logical Verification. Logic is a set of rules for combining separate events, facts, or experiences to arrive at conclusions. The syllogism is a formalized expression of a logical relation, as follows:

All x's are y's.
All z's are x's.
Therefore all z's are y's.

When stated abstractly, these relationships seem perfectly clear, yet most people find it hard to follow logical rules of thought. Suppose we say:

All communists think Marx was a great man.
This American thinks Marx was a great man.
Therefore this American is a communist.

When we inspect this example, we see that the conclusion does not follow from the premises, yet it is the sort of judgment that people make in everyday thinking with great assurance. Let us change the wording a little:

All Russians think Marx was a great man.
This American thinks Marx was a great man.
Therefore this American is a Russian.

Few people would be misled into believ- this conclusion. Our concept of a Russian is much better defined than our concept of a communist, so that the error in logic stands out sharply.

In these examples the error crept into our logical thinking because we misused the rules. We can also make gross errors—

and often do—when we start out with false premises. Suppose we say, "All football players have more brawn than brains. Therefore if so-and-so, who is a football player, got a better mark on this test than I did, it's a fake!" Much of our thinking is illogical because it is based on false premises that are very dear to us. These are our attitudes and beliefs, of which we shall have more to say presently. What we want to point up here is that man, the thinking animal, is not a purely reasonable creature. The direction and course of his thinking, even his so-called logical thinking, is influenced by his underlying pattern of motivation.

The Goals of Thought. The different forms of thinking we have discussed are *alike in that they are learned patterns of* motivated activity, directed toward the achievement of a desired goal or reward. Many of the goals of thought are intrinsic in the thought-activity itself. The learning that occurs during thinking serves to set up what might be called symbolic motivation —that is, the motivation to use symbolic procedures for their inherent satisfactions. Most of us like puzzles and brainteasers in the same way that we like a good *story or joke. The symbolic manipulation* involved serves as its own reward. Many scientists and thinkers pursue their problems just for the satisfactions in achieving a solution. The "eureka" experience in insight is a high point in symbolic activity, a tremendously rewarding goal.

The controls we level on different types of thought—that is, the type of verification we use—depend on the nature of the goals. The activities of dreams and fantasy (Fig. 12.16*a*) *need not* be checked or verified by additional observations. Their control lies within the individual himself, in the patterns of emotion and frustration which they express. The expression of fantasy may be private or it may take the form of literature or art, influencing the lives of others as markedly as scientific thought.

The activity of the logical thinker work*ing with his symbols in Figure* 12.16*b may* not be far removed from the thought game, the joke, the humorous cartoon, or the manipulation of ideas in a mystery novel. All of these forms of thinking have built-in rewards, and need not be subjected to outside verification. The conclusions of mathematical problems or logical syllogisms can be reached and accepted without further proof because their validity is defined by the consistency of the symbolic *relations involved in them. We can illus*trate this point by means of a thought problem. How do we know that there are at least two people in London with the same number of hairs on their heads? We know this to be true because there are more people in London than there are hairs on a human head. Thus we present a situation which is symbolically consistent and valid, but can never be tested by direct observation. A good joke also must be *internally consistent, even though the situ*ation described may have no perceptual reality.

Finally, there is another kind of thinking wherein the goal consists of objective verification. The amateur scientist in Figure 12.16*c* has asked himself the question, "Why don't spiders get stuck in their own webs?" After thinking about it for awhile, he concludes that spiders must have some special substance on their feet which prevents their getting stuck. In order to verify this symbolic conclusion, he kills a spider

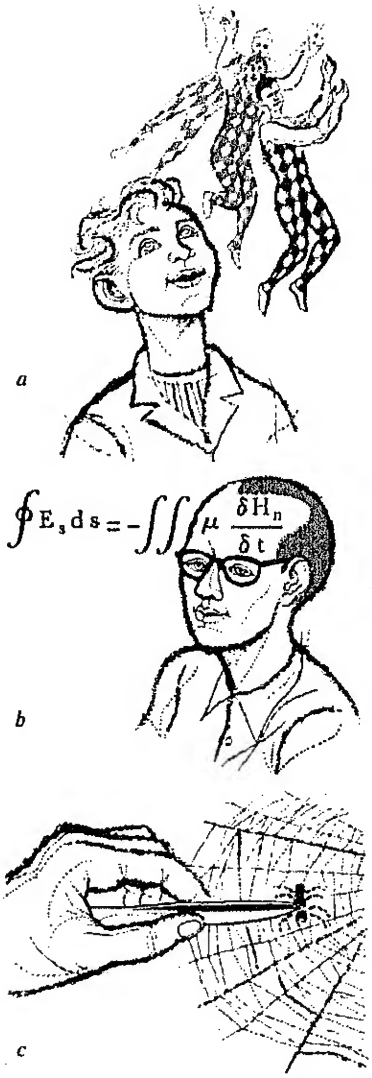


Figure 12.16. The goals of thought. Fantasy, a, *and the manipulation of ideas,* b, *have intrinsic rewards, whereas practical and scientific thinking are usually directed toward objective verification. The amateur scientist must test his thinking to discover that spiders spin two kinds of strands in their webs—sticky and nonsticky.*

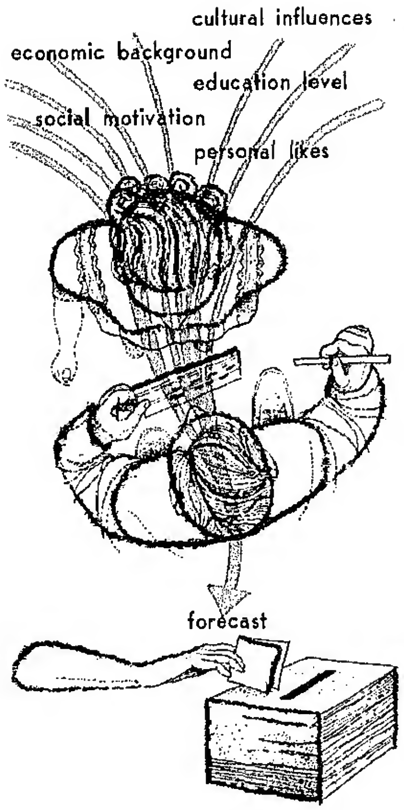


Figure 12.17. Attitude analysis. The attitudes expressed by the housewife reflect many different influences in her past, and in her present emotional and perceptual behavior. The predictive value of an expressed attitude depends on how valid an expression has been obtained and whether the attitude is in the process of change.

and then carefully applies the tips of its feet to different parts of the web. He finds that the feet do stick to certain parts of the web. His original conclusion must be rejected, but in testing it, he happens on the correct answer. Practical thought, social thinking, as well as scientific thinking, depend on verification by observable events. In ordinary behavior our pragmatic and social concepts are being formed and changed constantly by these processes of objective testing.

One of the requirements for effective thinking is for the individual to recognize the different forms of thought and how they are influenced by motivation. It is especially important that we distinguish between the tentative concepts that we form about our everyday affairs and logically valid conclusions. We are too prone to assume that we ourselves are thinking logically, while others are most illogical. The fact is that much of our thinking is based on attitudes and beliefs that are emotional, not logical, in origin.

ATTITUDES

Human attitudes are learned patterns of symbolic responses associated with objects, persons, or situations. In general, our attitudes are either favorable or unfavorable, reflecting their emotional or motivational character. Our common attitudes are complex patterns of opinions and beliefs related to self, to other people, to home, family, school, work, and so on. For example, a woman's attitude toward her church is made up of a number of favorable components—her beliefs about the Bible and God, the church building, the pastor—but also may incorporate negative feelings, perhaps toward the social activities and the congregation. Yet, on the whole, her attitude toward the church is favorable, and its strength is expressed in how often she actually attends church and the extent of her participation in church activities. The attitude of a man toward his job consists of specific beliefs about working conditions, the management, pay, pensions, duties, and the company. Although his overall attitude may be negative, he stays on the job because he has no other means of livelihood.

The very complexity of beliefs and actions involved in attitudes is the source of much human conflict. The man holding a negative attitude toward his job is forced into a state of sustained frustration because his negative attitude conflicts with other beliefs and needs which motivate him to keep it. Attitudinal conflicts are the origin of the most serious forms of human frustration.

Factors Influencing Attitudes. The psychological study of attitudes involves first of all devising techniques of measuring them. The most common method is by interview or questionnaire. The interviewer in Figure 12.17 is questioning the housewife about the nature of her attitudes toward a group of candidates in a forthcoming election, as well as her general political attitudes over the course of the previous ten years. His purpose is to understand some of the factors which helped form her political attitudes, and at the same time forecast how she will vote on election day.

We know from such studies that since attitudes are learned, they are subject to many influences throughout the life of the individual. The cultural framework into which we are born determines some of

our most general attitudes—what we think about forms of government, the status of women, the value of education, and so on. Individuals who identify themselves with their cultural background in general accept the attitudinal patterns that prevail within it. More specific attitudes are influenced by the social groups to which the individual belongs, his parents, family, and friends. The housewife in the picture may derive her political attitudes from her parents or her husband. Other attitudes are influenced by religious, economic, occupational, geographic, and educational groups, which set standards and exert pressures that make for conformity in thinking among group members.

The social structuring of attitudes can occur, however, only within the frame of reference of the individual's organization of behavior. His emotional make-up, his general patterns of motivation, needs, and habits of thought which have been formed in prior experience, establish a *context* within which an attitude is formed, persists, or changes. A person who is at odds with his parents may reject his previously learned parental attitudes. Thus in some persons attitudes change relatively quickly as the individual changes his family or group loyalties. On the other hand, some people show strong defensive reactions with respect to their own attitudes and beliefs. Any threat to their attitudes is taken as a threat to their own self-esteem. Under these conditions, an individual's attitudes are very resistant to change.

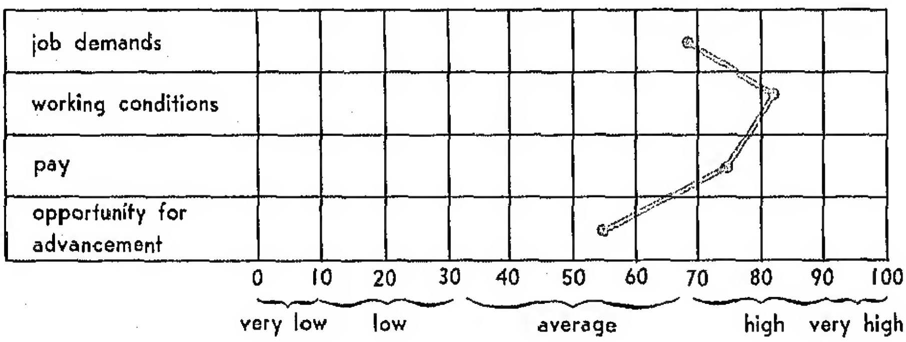
The housewife facing the interviewer has attitudes which have been influenced by these many factors prior to the present moment—cultural, social, family, and individual factors. Now she is asked to express her attitudes by answering specific questions. Is this expression valid? We must recognize that her present reactions are determined in part by her immediate emotional state—whether she is happy or depressed and anxious—and especially by her overall perceptions of the interview situation. Her expressed beliefs and opinions are influenced by her perception of the interviewer, the nature of his questions, and subtle patterns of nonverbal behavior that he displays. The first problem of attitude measurement is to minimize the effects of the immediate situation on the individual's expression of attitudes.

The predictive value of an expressed attitude depends on how valid an expression is obtained, and whether or not the attitude is in the process of change. The housewife's reactions during the interview may or may not give an accurate indication of how she actually will vote. When we measure attitudes, then, we are concerned with improving our techniques so as to get as accurate an expression as possible, and at the same time to understand how and why attitudes change.

Attitude Measurement. Assessing political attitudes, as in the example we have just described, has become familiar to us through the activities of public opinion polls and the like. There are many other uses of attitude measurement, especially in areas of human relations. As an illustrative study, we can describe an investigation of attitudes in a large industrial organization, carried out to obtain information that could be used by the management to improve working conditions and to establish better communication between workers and management.

In the first phase of this study a standard attitude scale for industry was admin-

Figure 12.18. Attitude profile of industrial workers. The workers filled out an attitude scale covering 15 categories, including the four shown. The values on the base line represent national norms. [Adapted from an Employee Inventory published by Science Research Associates, as used in Farwell, F. M. What you think about your company. *Jonwax J.*, 1953, 25 (5), 3–19.]



istered to all people in the organization. The 75 items in the scale cover 15 categories, such as working conditions, pay, employee benefits, confidence in management, and so on. For example, the category of job demands contains the following five items:

a. The hours of work here are okay.
b. I often feel worn out and tired on my job.
c. They expect too much work from us around here.
d. My job is often dull and monotonous.
e. There is too much pressure on my job.

In order to assure the employees that their expressed attitudes would be kept confidential, the scale was administered and scored by a university research bureau, which then reported a summary of the combined results to the company.

Part of the results of this study are shown in the attitude profile in Figure 12.18. Expressed attitudes in the other 11 categories are comparable to the four shown. The employees of this plant showed more favorable attitudes in every category than the average of employees of many industries throughout the United States, with especially high attitudes toward working conditions and security in job relations.

The main advantage of attitude measurement in industry is that it provides an effective means of communication between labor and management groups on topics of mutual concern. However, if an atmosphere of cooperation does not already prevail in an organization, an attitude survey has little practical value. The usual procedure after a survey has been made is to try to correct weak spots that have been indicated, and report these corrections to the employees with the end in mind of raising the general attitude level. It has been found that little progress can be made unless the proposed changes and corrections are discussed with employee groups, and their ideas solicited. Attitude change seems to depend on sustained positive action on the part of both management and workers, and continued, effective interplay of ideas between the two groups.

Attitude Scales. When psychologists talk about attitude measurement, they typically use the term attitude *scaling,* which refers to the process of obtaining a series of statements or expressions of belief having a quantitative meaning ranging from a positive or favorable point to a negative or unfavorable point. Suppose we are interested in constructing a scale to measure attitudes about the United Nations. The first step is to collect a large number of statements expressing an opinion or belief about the U.N. Our list might include such statements as, "The future of the U.N. is the most important problem facing this country today," and "It is an honor to have the U.N. headquarters in our country." The next step is to administer these sample items to a large enough group of people to get representative responses. These people are asked to mark each item

according to the strength of their opinion about it: "Strongly agree," "Agree," "Uncertain," "Disagree," or "Strongly disagree."

The third step is to analyze the results of this sample test to find which statements give results that are consistent with the total results of the test. Items which do not correlate highly with the scale as a whole are eliminated, because it is assumed that they do not measure the same attitude pattern that is measured by the whole scale. The remaining items, those that correlate most highly with each other, constitute the standard form of the scale. The quantitative nature of the scale is established by giving the standard form to a representative group of people in order to obtain a normal distribution of scores. Thus an individual's score on a standard scale has meaning in terms of the distribution of scores of a normal group of people. An attitude scale of this sort has no zero point but is based on a mid-point representing the average scores of a normal group, and measures intensity of attitudes which deviate in both directions from that mid-point.

Attitude scales measure intensity and direction of attitudes but do not tell us much about the component factors making up these patterns of thought. In order to analyze attitudes, we use other procedures, such as interviews, free association tests, or other tests. In the following study, attitude factors relating to college adjustment were analyzed by having students describe concrete incidents which had given them definite feelings of satisfaction or dissatisfaction in their college life. Figure 12.19 shows the results of this "critical-incident" analysis obtained from 50 male students who were asked to write down on separate cards each definitely satisfying and dissatisfying incident that they could recall. Of some 200 incidents described, 160 fell into the well-defined categories shown in the figure. In a group of women students, incidents relating to honors and teachers were named most frequently as satisfactions, whereas courses and teachers were the most frequent sources of dissatisfaction.

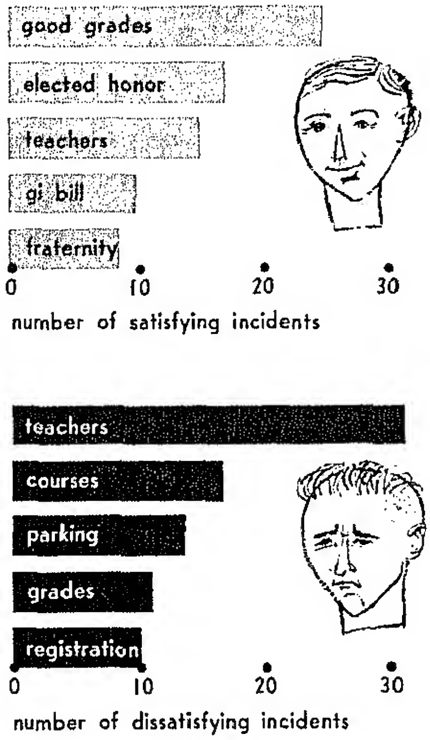


Figure 12.19. Satisfactions and dissatisfactions in college life. Attitudes of students toward their college life were analyzed by the method of critical incidents. (Unpublished data from Gerald Behling.)

Studies such as this one reveal that favorable and unfavorable attitudes may or may not have the same sources, and do not necessarily vary along a uniform scale. One person has his overall attitude toward a situation defined by one pattern of people and events, while another person has quite a different organization. The general attitude survey can be used for group

measurement and predictions, but must be used cautiously when we try to predict behavior in the individual.

Attitude Persistence and Change. A high point in the study of human motivation and thinking is the understanding of how and why attitudes change, and how susceptible different attitudes are to outside influence. The applied fields of advertising, selling, propaganda, and many phases of education are primarily concerned with controlling human attitudes and beliefs.

Our approach to the problems in this field is to try to relate certain situational factors with individual characteristics to determine the effects on attitudes. For example, we might ask, as Newcomb did in a study of attitude persistence and change among girls in a small liberal college, what decisive factors influence habits of thought during the process of higher education?[15] During the period of this study, the girls attending Bennington College were predominantly conservative when they entered college, reflecting the attitudes of their parents. In the decidedly liberal atmosphere of the college, most of them changed decisively during their four years there. In a class of graduating seniors, those who changed were the girls who identified themselves closely with the college group and adopted the prevailing opinions and beliefs in order to gain approval and acceptance. The chosen leaders were usually those girls who expressed the most liberal opinions. The minority of senior girls who had persisted in conservative attitudes in this liberal climate still identified themselves more closely with their parents than with the college. Their resistance to attitude change was apparently related to general habits of defensiveness which they had learned in order to protect themselves from feelings of inadequacy and nonacceptance.

The problem of predicting shifts in attitudes is one that concerns the businessman and politician particularly. In one important survey, political attitudes during the presidential election year of 1940 were studied in a representative county over a period of six months prior to election day. In May, an adult in every fourth house of the 12,000 houses in the county was interviewed regarding his political intentions in November. From this large sample, four attitude panels of 600 persons each were selected in such a way that they were matched in terms of economic, political, educational, and religious status. One panel, the experimental group, was interviewed every month prior to the election, and once after the election to determine how each person had actually voted. The other three panels, serving as controls, were interviewed one more time in addition to the original interview, the time varying for each group, in order to check on the possibility that repeated interviewing would distort the results obtained with the experimental group. Figure 12.20 shows the design of the experiment and the results obtained with the experimental group. As seen in the bar graph, only 8 percent of the voters actually shifted their voting intention during the six-month period, 15 percent vacillated but finally voted their original choice, 28 percent who showed no choice in May were equally divided between Republicans and Democrats in November, and 49 percent showed no change at all during the campaign.

These results indicated that the great majority of voters did not change their attitudes during a political campaign in spite

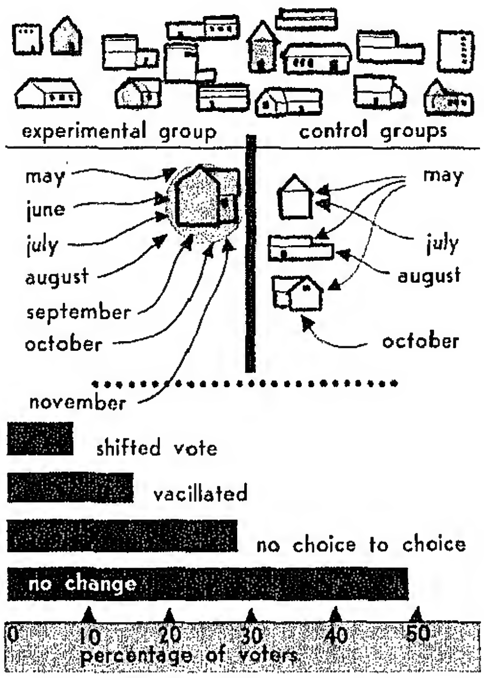


Figure 12.20. Political attitudes in an election year. An adult in every fourth house in a county was interviewed in May to make up one experimental and three control groups. The bar graph shows the relation of votes in November to attitudes expressed in May. (From Lazarsfeld, P. F., Berelson, B., and Gaudet, H. *The people's choice.* New York: Duell, Sloan, and Pearce, 1944.)

of the heavy barrage of propaganda. However, there was some evidence that people who were exposed almost exclusively to propaganda from one party were influenced to vote for that party. The general conclusion was that elections are decided by a relatively small percentage of the voters who are susceptible for one reason or another to attitude change.

Studies of attitude change and persistence tell us that the processes of forming and modifying attitudes are not much different from other forms of learning, in that they involve attempts by the individual to achieve desired goals, to find acceptance in a social group, to solve problems, or to alleviate frustration. Acquiring new attitudes is not just a matter of deciding to do so; it is essentially a matter of breaking old habits and making new ones (see p. 78 ff.). To change attitudes in ourselves or others, it is necessary to set up positive goals for such a change and to counteract those factors contributing toward resistance to change. In influencing relatively uncomplicated attitudes, such as reactions toward consumer products, the search for qualities and characteristics in keeping with established motives and needs is most significant. When it is important to shift attitudes toward some general situation, such as modifying workers' attitudes toward their jobs, we must take into consideration the importance of such social factors as group affiliation and participation.[16] As we indicated in connection with the industrial attitude survey, the technique of group decision is effective in influencing performance in jobs, as well as improving the general attitude level. Role playing also is an effective way of breaking down personal barriers in thinking and in forming new attitudes about problem situations. Generally speaking, inducing attitude change should be looked upon as a difficult, long-term process in which every factor of human motivation and habit formation must be considered.

SUMMARY

Thinking is the process of abstractive integration, in which the individual uses abstract symbols, or concepts, and can integrate these symbolic activities to short-cut the learning process. Animals show simple symbolic behavior and rudimentary forms of integrative learning, but are limited in their use of abstract symbols. Children by the age of three or four clearly meet the criteria of true thinking.

The evolution of thought in the individual proceeds from the prelingual stage, through symbolic, concrete, relational,

and creative activity. Creative thinking typically reaches maximum efficiency in the thirties.

The experimental study of the formation of concepts shows that they are likely to develop in much the same sequence as thinking in children, with object concepts first, then spatial and numerical concepts. Concepts can be developed and used without being verbalized.

Thinking activity differs in degree, rather than in kind, from nonthinking activity, as shown in its evolution in animals, in the individual, and in the race. The peripheral theory of thought emphasizes this continuity in describing thought as a pattern of sensorimotor behavior, as distinct from its description in the central theory as a brain process.

Our so-called "uncontrolled" reverie is guided by both external and internal stimuli. Autistic thinking is controlled almost exclusively by the emotions and needs of the individual.

Problem solving can be hampered if the individual becomes frustrated and shows stereotyped behavior. Habits of thought, or fixed sets, also limit variability of response in problem situations. Attitudes are relatively permanent thinking sets based on emotional patterns which guide much of our thinking.

Truly creative thinking is characterized by flexibility and originality in problem solving. Creative thought has been described as following the stages of preparation, incubation, inspiration, and verification.

The rules of logic help us to verify our thinking when it cannot be checked against objective criteria. However, emotions and attitudes hamper the correct use of the rules of logic.

The goals of thought may be intrinsic in fantasy, puzzles, jokes, and symbolic manipulation. Practical, social, and scientific thinking depends—or should depend—on objective verification.

Attitudes are emotionally based habits of thinking made up of opinions and beliefs about objects, persons, or life situations. An attitude may have both positive and negative components, leading to conflict and frustration.

Attitudes are learned, and are influenced by cultural, social, and individual variables. The expression of an attitude is also influenced by the immediate emotional and social context.

Attitude scales measure intensity and direction of attitudes. Other procedures, such as a "critical-incident" analysis, are used to study the component factors making up attitudes.

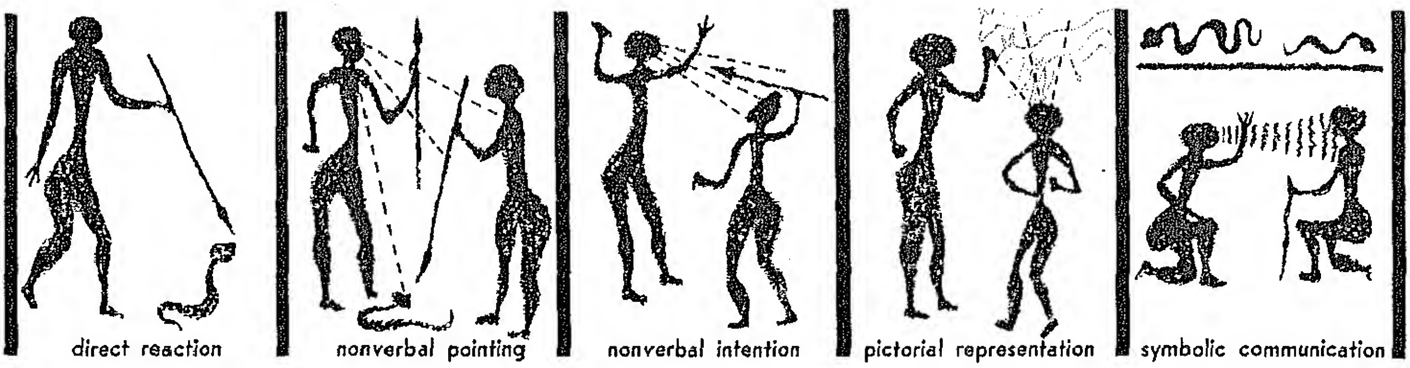
Attitudes are relatively persistent, but change with relation to the problems, goals, and emotional habits of the individual. The changing of attitudes is a difficult, long-term process similar to other kinds of habit making and breaking.

CHAPTER 13. VERBAL BEHAVIOR

Among the patterns of response that serve man in his adjustment to his environment, verbal behavior is perhaps the most outstanding. Here is behavior in its most highly refined form, a perceptual-motor skill so intricate that it almost defies analysis. Hundreds of thousands of distinct words can be spoken and perceptually discriminated by the human individual, and the organized patterns of words used in verbal communication are limitless.

However, the real significance of verbal behavior lies not in its intricacy as a skill, but in its function as a behavioral network binding aggregations of people into organized groups. Societies—animal or human—are based on the abilities of their members to communicate among themselves. There are many forms of communication, both verbal and nonverbal. In man, the nonverbal patterns—bodily postures, emotional expressions, gestures—establish the mood or climate for social interchange, while verbal behavior makes possible the exchange of detailed information and many variations in meaning.

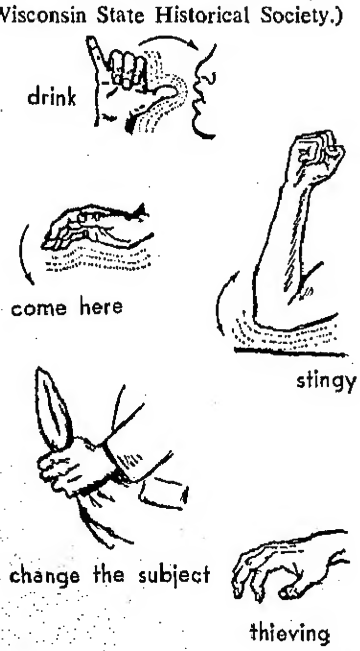
Verbal language, spoken and written, is a uniquely human form of behavior, which *more than any other thing sets man far* beyond the capabilities of other animals. In all forms of adjustive behavior, language is man's tool—to communicate with others, to aid in learning and in solving problems, to refine perception, and to facilitate the processes of thought. In an-



a *b* *c* *d* *e*

Figure 13.1. Evolution of communicative behavior. Communicative behavior develops out of direct reactions to stimuli, a. *The action with the spear can be used to point out an object,* b, *or to communicate intention,* c. *At a higher level are pictorial,* d, *gestural, and verbal,* e, *communication.*

Figure 13.2. Gestural language signs. These Guatemalan Indian signs are examples of language meanings conveyed nonverbally. (Courtesy Wisconsin State Historical Society.)



other sense, language is man's master, when used by others to control him, to attack him, to promote ignorance, or to distort the truth. Our task in this chapter is to see how verbal behavior is organized, how it is related to nonverbal communication and action, and how its elements—words, sentences, and paragraphs—acquire meaning.

THE NATURE OF COMMUNICATION

Communication involves no new principle of behavior, differing from other adjustive behavior only in the functions it serves in social interaction. At its primitive levels, it is a part of the basic forms of social behavior. At the level of gestural and pictorial language, it is used to point or signal, to aid in anticipating events, and to improve social cooperation. At its highest level, in verbal behavior, communication achieves all these ends and others too. It creates radical short cuts in social action, making possible social interaction at a distance and implementing both memory records and written records of individual and social history. It facilitates individual and group problem solving, and above all serves as the vital instrument for all systematic forms of human thought.

The evolution of different forms of communicative behavior out of simpler reactions is suggested in Figure 13.1. In Figure 13.1*a* the primitive individual is using his spear in a direct reaction to attack a snake. If another individual is present, the same sort of reaction with the spear serves a communicative function, to point to the object and indicate something of its nature (*b*). In Figure 13.1*c*, the reaction with the spear denotes not an object but an intention to attack, thus communicating a response meaning rather than an object meaning. These nonverbal expressive reactions are primitive forms of communication which have existed as long as animals have roamed the face of the earth. At a much higher level of complexity are pictorial (*d*), gestural, and verbal communication (*e*). The significant advance in the higher forms of communicative behavior is that they consist of symbolic reactions rather than direct reactions. When individuals exchange information by means of a set of systematized symbols having consistent and meaningful relations, we say they are using a language. Although most of us are most

familiar with verbal languages, these are by no means the only possible ones. Deaf-mutes use a variety of manual signs to communicate with each other, although they also resort to spelling out words. The American Indians developed a universal sign language, using the arms, hands, and fingers, with which they could communicate very successfully. The drawings in Figure 13.2 represent some of the signs used by the Guatemalan Indians, along with their meanings, as nearly as they can be conveyed in English words.

Nonverbal Communication. If language is considered as somehow distinct from the other behavior of the individual, it becomes mysterious and without objective foundation. But if it is considered a part of adjustive activity, its functions in emotion, motivation, perception, and learning become understandable. Only an objective view of language will enable us to know how word meanings and concepts can affect the behavior and physiology of the individual, how labels and epithets can induce fighting reactions, or how word suggestions can set up trance states or attitudes of cooperation in individuals.

The use of words is but one aspect of broad patterns of communicative behavior. The photographs in Figure 13.3 suggest how much we use and depend on nonverbal communication in social interaction. It plays a major role in communicating states of emotion and motivation to others.[1] Babies communicate their wants and their general emotional state long before they learn to talk (*a*). Even among older people emotional interaction depends as much on nonverbal behavior as on verbal. Patterns of love and intimacy need no spoken or written language, and

a

b

c

d

Figure 13.3. Forms of nonverbal communication. a. *Emotional and motivational needs, from infancy on, are communicated by nonverbal patterns of behavior as well as verbal.* b. *Many art forms are based on nonverbal communication.* c. *Work groups coordinate many of their activities by nonverbal communication.* d. *Verbal behavior is ordinarily closely coordinated with nonverbal, making up a total communicative pattern.* (*a* and *c*, courtesy Marion Hansche; *b*, Wisconsin State Historical Society; *d*, Johnson's Wax.)

may in fact be disturbed by the use of words.

All forms of art, aside from the exclusively verbal forms, are based on patterns of nonverbal communication. Expressive movements of the body, as in the dance and in the closely related actions of pantomime (Fig. 13.3*b*), convey not only specific information but also define particular life roles. The talent of the stage artist depends on his skill in nonverbal communication; anyone can read a part, but only an artist can give it life. Perhaps the greatest achievements of art, both in visual and auditory form, are in conveying some human meaning immediately, without thought, and without requiring verbal interpretation. However, many art forms complement verbal language. The drawings and paintings in this book, for example, have been designed to integrate with written objective descriptions of behavior and thus expand knowledge by nonverbal means.

In many social activities of work and play, nonverbal behavior confirms and supports verbal behavior. The two horses and four men in Figure 13.3*c* are coordinating their work activities using few, if any, words. As a rule, verbal behavior in a well-organized work group is required only when something unusual happens. Almost every type of job and profession has its own pattern of nonverbal communication, made up of gestures, postures, and the use of the tools of the job. Among skilled workers, verbal behavior often becomes a pastime—a means of recreation—carried out while nonverbal communication goes on to keep the work in progress.

The close integration of verbal activity and nonverbal is shown clearly in Figure 13.3*d*. The man and the woman are expressing with facial movements, gestures—in fact, with their whole bodies—how totally involved they are in this conversation. Human society is built on verbal communication, and our preoccupation with words is so great that we are likely to endow them with a somewhat mystical life of their own. However, words have their marvelous powers only as they are organized into the adjustive behavior of individuals. The meaning of a word is not inherent in the marks which represent it on paper or in the pattern of sound waves which carry it from one person to another. The meaning of a word lies in its behavioral significance to the person who speaks it, or hears it, or reads it.

Verbal Language. Of all the languages that have been used by man, verbal speech is at once the most complicated and the most efficient. There are many advantages to a form of communication that utilizes the vocal apparatus. In the first place, as we shall see, there is an almost limitless variety of movement patterns that can be produced in speech, permitting great flexibility in language forms. Then, too, vocalizations have the advantages inherent in auditory, rather than visual, signals. A spoken word can be heard at a distance, or around a corner, or in poor light, or by a person whose back is turned. A visual signal to be effective must, of course, be seen. Finally, people who communicate with each other by vocal speech have their hands free for other tasks. One of the primary uses of speech is in cooperative human enterprises. If the hands are preoccupied with lifting or carrying or some other task, they cannot at the same time be used to carry on a conversation.

The advantages inherent in vocal communication have contributed toward the development of human speech. The first form of speech in the history of the race was spoken language, followed much later by written language. Some forms of writing, such as those developed by the Chinese and the Egyptians, represented words or groups of words by single characters derived from a picture or pictographic symbol of an object or event. Another type of writing, such as our own, evolved some 5000 years ago in the Middle East as a system of representing by written characters the syllables used in speech.[2] It was syllable writing, as contrasted to the use of written symbols to represent meanings or ideas (ideograms), which made possible the evolution of phonetic writing based on an alphabet.

The primary function of speech is a social one. Words are spoken to be heard by someone else, and they are usually written to be read by someone else. Furthermore, the patterns of oral and graphic language are defined to some extent by the social situations in which they are used. Even the same words when used in different contexts do not always mean the same thing. It is these different situational uses of language which help define meanings. Slang phrases are exaggerated examples of this dependence of language on social context. "Real corn" can mean a number of things, depending on the people who use the phrase as well as the situation in which it is used.

Both oral and written language go beyond simple interpersonal communication. They serve as essential parts of the adjustment of large groups, as in conference behavior, public speaking, and related leadership activities. In very complex groups, language is essential to define and structure social roles. Our whole system of government, for example, is based on language. The legislative branch writes the words, the executive branch carries out their instructions, and the judicial branch is called upon to help define what the words mean in terms of the behavior of citizens.

We can summarize some of the functions of verbal behavior in Figure 13.4. The pointing hand indicates the primary function of communication: that of pointing to objects or events in the perceived environment. Spoken and written language also serves as a refined method of pointing. The expression "Look here!" or "Look there!" directs the behavior of another in much the same way as a pointing finger.

A word or group of words can serve as a direct stimulus just as any other form of stimulus energy. An animal or person learns that certain stimuli *signal* certain related conditions or events in the environment. Thus the presence of smoke is a signal for fire. The spoken or written word "Fire" also signals fire, but only among people who arbitrarily use that word as a *sign* or symbol. There is nothing inherent in the word itself which resembles the event, fire. The use of language symbols is conventionalized, social behavior which becomes standardized in a culture. People who communicate with each other through language can make anything stand for anything, as long as they agree on rules and meanings.

Word symbols aid in the discrimination, identification, and classification of objects and events by providing systematic ways of identifying likenesses and differences. For example, if you learn names for all the varieties of butterflies, you can identify and remember different species more easily.

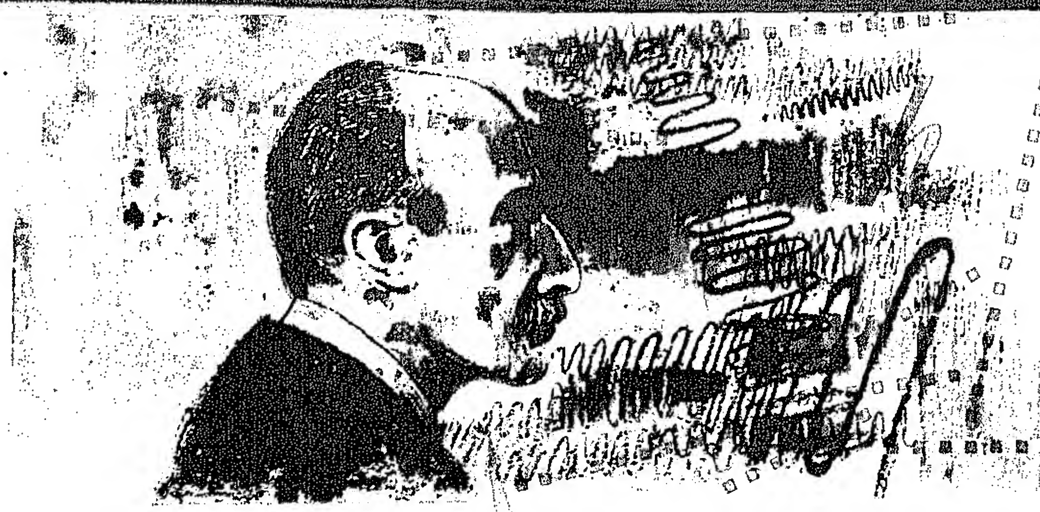


Figure 13.4. Functions of language. A primary function of language is to point out objects or events in the environment. Language symbols are also used as signs of objects or events, and aid in identifying and classifying objects. A written symbol can be thought of as a sign of a sign. Language is used to signify or manipulate events at a distance, in emotional behavior as well as in abstract thought.

This facilitating function of language in perception has been demonstrated experimentally. Children discriminated nonconventional geometrical forms better when each form was given a distinctive nonsense syllable name.[3]

The higher functions of language indicated in Figure 13.4 are concerned with the ability of man to make use of language symbols in adjustive behavior without immediate reference to the objects or events for which those symbols stand. By developing systems of writing, man has been able to handle or manipulate events and ideas at a distance, either spatial or temporal. A spoken word is a sign, and a written word is a sign of a sign. The latter preserves an event of human behavior for a later time or for other people. Words serve, too, as emotional stimuli. They can soothe or excite. Some words, such as those used in name calling, can have the same effect as direct bodily aggression. The emotional words of religion or patriotism represent some of the most potent forces of motivation among mankind. Once an individual learns words, he can stimulate himself through their use. It is probable that much of human thinking is carried on in terms of words and related symbols. Such symbols have the outstanding function of standing for general ideas or abstract concepts. The painting of Max Planck at the top of the figure denotes the use of a letter symbol to stand for a general physical characteristic of the universe. This symbol, Planck's Constant, applies to all types of energy, much as the word "tree" is used to identify all kinds of objects, varying from the 300-foot sequoia to an artificial tinseled object which we use to decorate our dinner table at Christmas time.

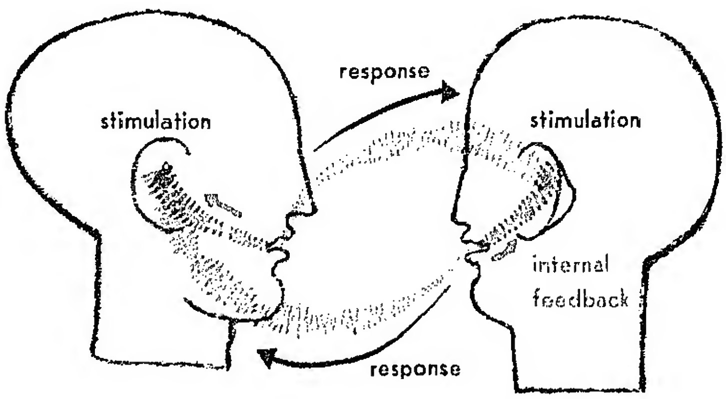


Figure 13.5. Behavioral interaction in the use of language. Speech involves two active processes—speaking and listening. The speaker controls his speaking movements both in terms of the auditory feedback from his own words and according to the vocal response of the listener.

Behavioral Interaction in the Use of Language. The social nature of verbal behavior should not blind us to the fact that such behavior first of all is vocal activity of the speaker and perceptual activity of the listener. Figure 13.5 describes both the interpersonal nature of vocal speech and its individual response characteristics. Both the speaker and listener are reacting in the process of communication. First one individual speaks and transmits sounds to the listener, who then responds in kind. The production of the transmitted sound is more than a single restricted response. As the speaker utters words, the sound of these words is "fed back" to his own ears as well as being transmitted to the ears of the listener. The speaker controls and regulates his own speech in terms of this feedback. The listener at any given moment is not a passive receiver. In order to detect and understand the transmitted words, he reacts in implicit and overt ways typical of perceptual behavior. If the words are faint, he may cup his hands behind his ears in order to aid his reception.

As the individuals speak and listen and speak and listen in the interacting pattern of communication, other events are going on in the body of each. The words can

have general or very specific emotional effects. Marked organic processes may occur, especially if this is a heated argument. Attitudes and motivation of the participants may change. Learning takes place as the conversation continues. After the conversation has ended, it may persist in the memory of both participants for a long time.

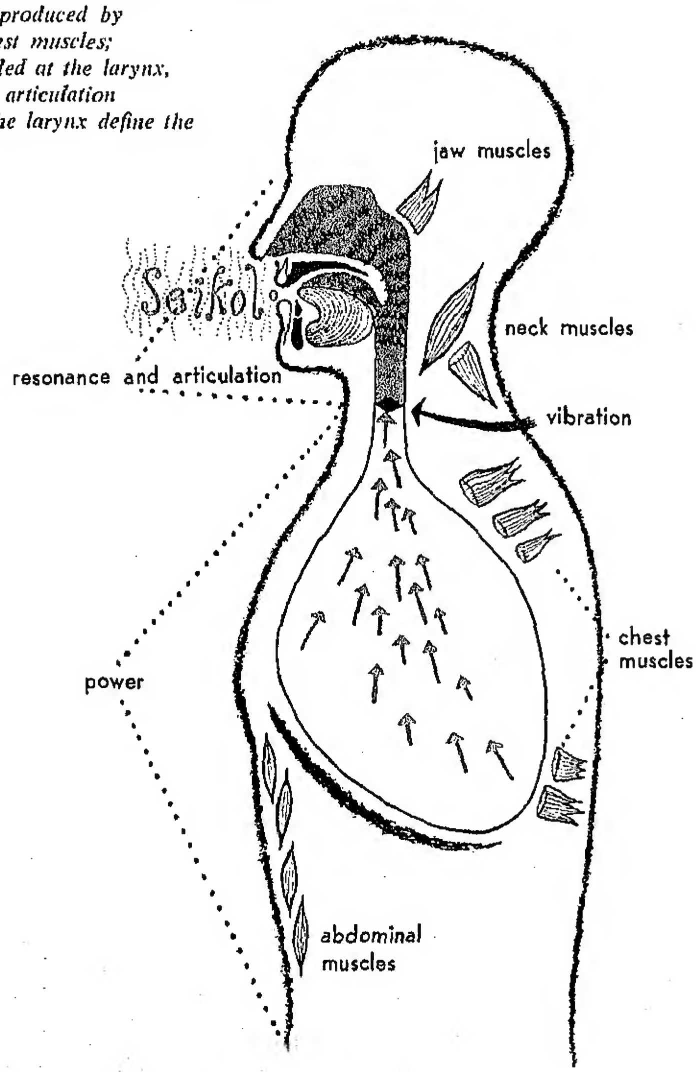


Figure 13.6. The speech mechanism. Speech is characterized by the expulsion of air from the lung cavities, through the larynx and the throat and mouth cavities. The units of speech, the syllables, are produced by movements of chest muscles; vocalization is added at the larynx, and resonance and articulation occurring above the larynx define the syllables further.

The patterns of verbal behavior, the interpersonal nature of language communication, and its integration into other forms of behavior are primary interests of the psychologist. The structure of the language system itself, as one of many such systems of symbols or signs, is studied in the science of *linguistics.* The study of language as behavior combined with linguistics defines the discipline known as *psycholinguistics,* or the science of verbal communication. To gain a broad understanding of language and its role in general behavior, we need to study each phase of the communication process.

SPEECH PRODUCTION

Verbal behavior depends on the ability of the human individual to organize movements to produce the specific sounds of speech. The analysis of speech sounds is important to our understanding of perception of language, but it does not tell us much about how these sounds are produced. Every detail of oral communication —consonant, vowel, syllable, speech rhythm, and sentence—is an expression of precisely controlled and integrated motions of the body. Just as every detail of a painting or every figure of a dance is related to specific skilled motions of the artist who produced them, every detailed sound of language is the auditory equivalent of learned, skilled movements of speech production. The following description of the organized movements of speech is based primarily on the work of Stetson.[2]

Characteristics of Speech. Human speech is characterized by several definitive factors, indicated in Figure 13.6. First, speech is produced by expulsion of air from the

lungs through the trachea (the windpipe), throat, and mouth. The power behind speech comes from movements of the abdominal muscles, diaphragm, and chest. The air flow during speech is not continuous, but consists of a series of discrete pulses, the *syllables* of speech. Syllable pulses are produced by quick strokes of the intercostal muscles between the ribs. The patterns or rhythms into which the syllables are arranged are controlled by movements of the larger muscles of the chest and abdomen.

The second characteristic of speech is that it is audible. It contains a certain amount of noise and also (except in whispered speech) tone. The tone is introduced when the pulses of air set up vibrations in the vocal cords or vocal folds of the larynx. Although this "voice box" is often thought of as being the source of speech sounds, actually the units of speech—the syllables—are initiated by the intercostal muscles, and tonal vibrations are set up by a difference in pressure above and below the larynx. Vocalization—that is, tonal quality—is not absolutely essential for distinguishable speech. When we whisper, we are producing speech without tone.

The detailed sounds of speech involve additional factors which are introduced above the larynx: the modulations and articulations of the throat and mouth. The size and shape of these resonating chambers determine the vowel quality of syllables, but the great variation and flexibility of speech is made possible by the articulatory movements of the jaw, tongue, and lips. The characteristic sounds which we call consonants are introduced into speech syllables by these articulations.

Patterning of syllables. Speech is not basically a pattern of sounds or a pattern of words. From the point of view of speech production, it must be thought of as a pattern of syllables. The syllable is the basic unit of speech and cannot be subdivided. Tone quality, vowel quality, and consonant quality are auxiliary effects integrated into the syllable pulse.

Continuous speech is made up of a train of syllables which occur in characteristic rhythms and patterns. Whereas syllables themselves are initiated by movements of the rib muscles, the whole pattern of speech is supported and regulated by movements of the larger muscles of the outer chest wall, the diaphragm, and the abdomen, as shown in Figure 13.7. The largest speech unit, the *phrase*, is defined by the necessity for inhaling more air into the lungs. A phrase may end at the end of

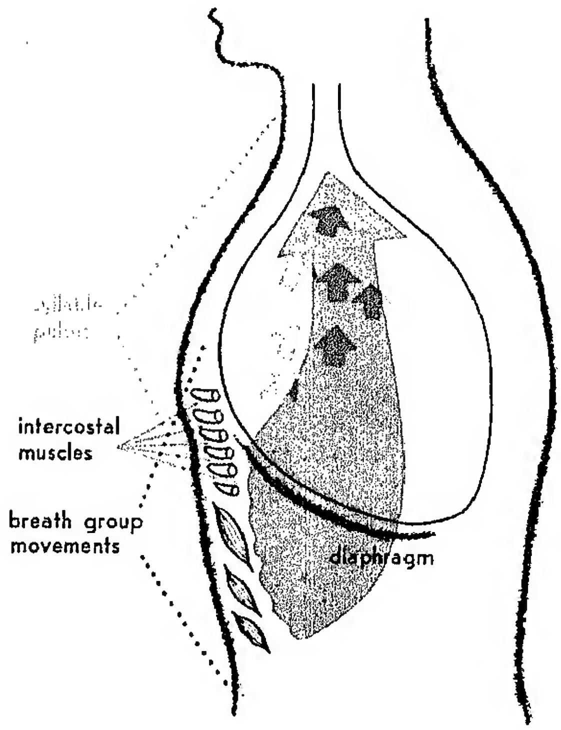


Figure 13.7. Syllable production. Syllables are the basic units of speech, and are produced by quick movements of the intercostal muscles of the chest. The larger muscles in the chest, abdomen, and diaphragm maintain air pressure and control breath group patterns.

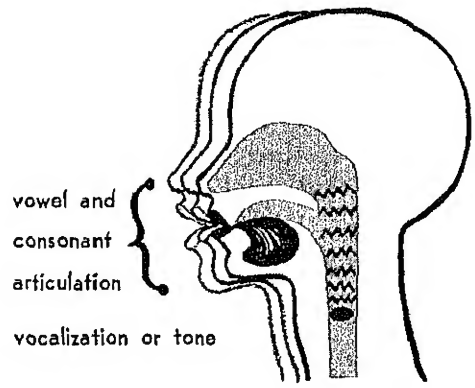


Figure 13.8. The syllable factors. Speech syllables are characterized by vowel quality and consonant articulations. Vocalization or tone is added at the larynx, while the size and shape of the resonating cavities and the articulatory movements define the syllable factors.

a sentence or clause, or wherever this inhalation occurs. It typically consists of smaller units called *breath groups,* which are defined by movements of expiration of the abdominal muscles. The pattern of a breath group is marked by syllables of varying degrees of stress. Adapting a term from poetry, the *foot,* we say that a breath group may contain several feet. A foot consists of one stressed syllable which may have one or more unstressed syllables grouped with it.

These different units of speech can be described more clearly with an example. Say aloud this line of poetry: "How sleep the brave, who sink to rest, . . ." You have said eight syllables, grouped into four feet. You probably have patterned these syllables into two breath groups, and, if you did not inhale until the end, the whole thing constituted a phrase. These basic patterned units of speech are defined by the movements that make them, *not* by the sounds that are heard. A single ejaculation, "Halt!" is one syllable which is at the same time one foot, one breath group, and one phrase.

Speech is recognized in terms of its basic patterns and rhythms almost as much as by the articulatory movements which occur above the larynx. Just as a musical theme can sometimes be recognized when the rhythm is beat out, so can a familiar speech phrase be identified even when some of the articulations are not heard. As we learned in Chapter 5, infants learning to speak first learn the rhythm of the breath groups. The more precise articulations are added later.

Syllable factors. The syllable factors are introduced into the syllable at the larynx or above, as shown in Figure 13.8. The vowel quality is determined by the size and shape of the resonating chambers of the vocal canal and by movements of the jaw, lips, tongue, and velum, the flexible muscular membrane which closes off the nasal cavities from the throat. In nasal vowels the velum is open.

Every syllable must be started and stopped—that is, released and arrested. If the vocal canal is open, the syllable pulse is released and arrested by the intercostal muscles. A consonant is a partial or complete closure of the vocal canal, which either releases or arrests the syllable pulse. A consonant closure can occur anywhere in the vocal canal, from the glottis, which is the slit between the vocal folds, to the lips. A complete closure of the glottis, called a glottal stop, occurs rarely in speech, and is not an English consonant. The aspirate *h* is characterized by a partial closure of the glottis. In English we are more familiar with *gutturals* (closures at the back of the mouth, such as *g*), *linguals* (closures of the tongue, *t*, *d*), and *labials* (closures of the lips, *p*, *b*). The *t* in French is a *dental;* that is, the tongue touches the teeth.

A syllable always has vowel quality but may occur without a consonant. If we say "Oh!" or "Ah!" we are producing a syl-

lable with vowel quality but no consonant closure. When a consonant is added at the beginning of a syllable ("tea," "go," "lay"), the syllable pulse is initiated in the chest, builds up pressure behind the closure, and then is released by the consonant. A consonant at the end of a syllable ("all" "oat," "egg") limits the syllable by closing the vocal canal. A partial closure ("all") allows air to pass, but not as freely as before. Some syllables are both released and arrested by consonants ("pope," "tan," "lead").

The movements of glottis, neck muscles, jaw muscles, tongue, lips, and velum which define the consonants are coordinated closely with the chest movements which initiate the syllable. Articulatory movements cannot produce a voiced consonant independently. If speech sounds occur at all, they must be carried by syllable pulses. Teachers who try to teach the isolated sounds of consonants cannot produce the sounds except on pulses of air which constitute syllables.

The functions of the larynx. The larynx is a useful but not critical part of the speech apparatus. It does not originate the syllable, nor does it define the vowels. Only rarely does a consonant closure occur at the larynx. The primary function of the vocal folds is to add tonal quality to speech. Vocalized speech is of course very useful in carrying for greater distances than whispered speech and also in allowing for greater flexibility. The photographs in Figure 13.9 are frames selected from high-speed motion pictures showing the vocal cords in action. Notice the variation in size and shape of the cords in producing sounds of different pitch and loudness.

Occasionally an individual must have his larynx removed for medical reasons. Since there is no longer a connection between the mouth and the lungs, breathing is accomplished through an opening in the trachea. Such a person can still make the movements of articulation, but in order to make speech sounds, he must have some means of forcing air through the mouth. This can be done in two ways. With an artificial larynx, a device which leads air from the trachea into the corner of the mouth by way of a cylinder containing a vibrating reed, the person can relearn the coordinations of speech. He produces syllable pulses from the chest as before, tone is introduced by the artificial larynx, and the articulations of the mouth and throat act on these syllables to produce intelligible speech even though the air pulses are introduced into the mouth through an external tube. The other method is to learn to swallow air and expel it through the mouth in syllables from the esophagus. In each case, the articulatory movements are superimposed upon syllable pulses to produce speech.

Control of Speech Movements. The marvelous coordinations of human speech are commonplace skills in most individuals. The normal child starts learning these skills at so early an age, and practices them so constantly throughout life, that they become almost completely automatic. It is only when these coordinations break down, or when for some reason they do not develop properly in the first place, that the problem of control is of immediate concern to the individual.

Most of our skilled movements are controlled by kinesthetic cues, visual cues, or both. If we play the piano or type, for example, we depend on both visual direction and kinesthetic feedback to control

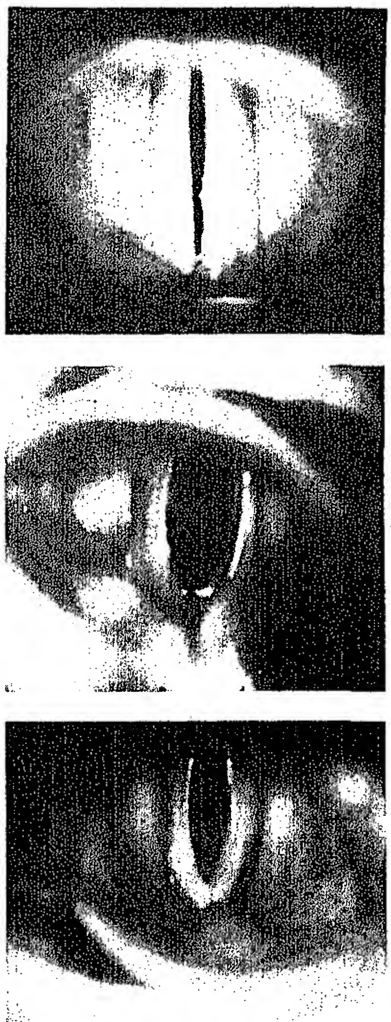
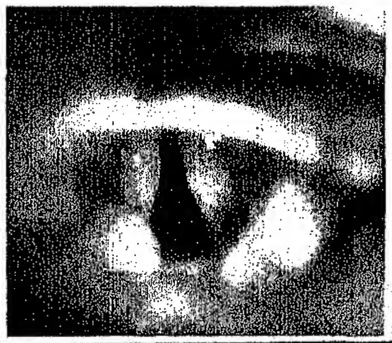


Figure 13.9. The vocal cords in action. These frames from high-speed motion pictures of the vocal cords show their variation in shape during (from top to bottom) falsetto, loud low-pitched tone, loud high-pitched tone, and whispering. (Courtesy Bell Telephone Laboratories.)



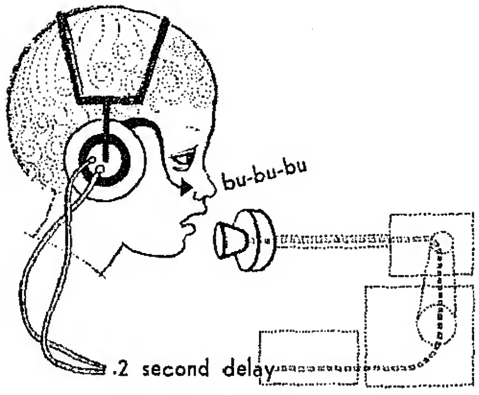


Figure 13.10. The effects of delayed auditory feedback in speech. When the subject's words are delayed so that she hears them a fraction of a second after speaking them, her speech falters and breaks down. (Redrawn from apparatus designed by Dr. Grant Fairbanks.)

the coordinations of fingers, hands, and arms. The movements of speech are somewhat different from other skills in that they produce audible sound patterns. Although kinesthetic feedback from the speech movements is important, our speech is controlled in large part by the sounds of our own voices—the *auditory feedback* from the sounds we are producing.

Figure 13.10 diagrams a very interesting experiment on delayed speech feedback. The subject is speaking into a microphone connected to a tape recorder. The electric circuit is such that the speech can be stored briefly and then played back to the speaker's ears through earphones. Thus she hears her own words a fraction of a second after she speaks them. If the delay introduced is about .2 second long, the effect on the subject's speech is very marked. She falters, begins to stammer, and soon gets so confused that she cannot go on speaking. Different individuals vary with respect to the amount of delay they can tolerate in the auditory feedback, but no one is immune to some disturbances.

This experiment illustrates to what extent speech coordinations normally are dependent on auditory control. Deaf persons face the problem of learning to control and coordinate their speech movements by other than auditory cues. The problem is, of course, most acute in children who are born deaf or become deaf early in life. Much study and research in the field of speech production has been motivated by the very practical problems of training the deaf to speak.

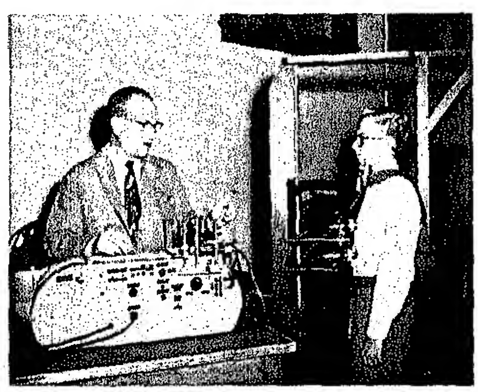


Figure 13.11. Speech training in the deaf with visual aids. The deaf boy's speech movements are recorded visually to help him learn to speak normally. (Courtesy Dr. Clarence V. Hudgins.)

Visible Records of Speech. In the absence of an auditory pattern of their own speech, the deaf need some other sensory pattern to help them in learning to coordinate speech movements. In the rare cases where a person is both deaf and blind, tactual and kinesthetic cues must be relied on. Helen Keller was taught to speak by touch. She learned to imitate the movements and vibrations which she perceived tactually on speaking individuals.

Deaf persons who can see can be taught to control their own speech by visual records of speech as it is occurring. These may be records of the muscular movements which produce the syllables and articulations of speech, or visible records of the sound patterns of speech.

The boy in Figure 13.11 is learning to control his speech movements by watch-

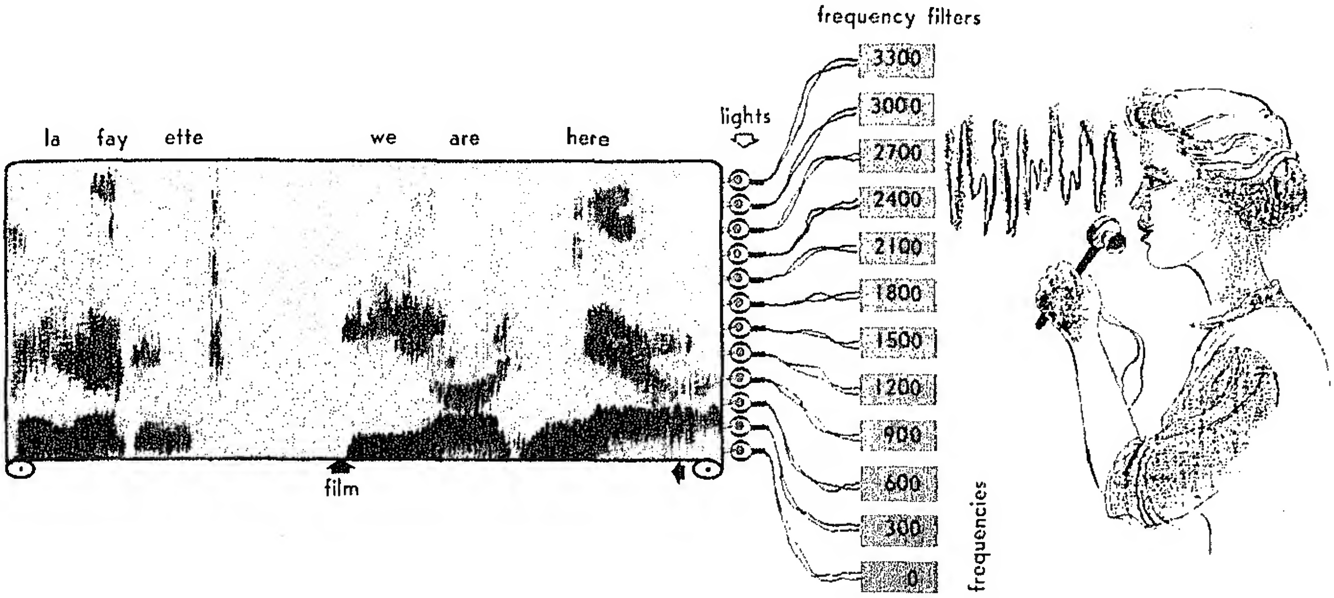


Figure 13.12. Visible speech. The sound spectrograph breaks down the sound pattern of a voice by means of a frequency analyzer into bands of frequencies, represented visually on a moving luminescent tape. The record shows the syllables of the phrase "Lafayette, we are here." (Record from Stetson, R. H. *Motor phonetics: a study of speech movements in action.* Amsterdam: North Holland Publishing Co., 1951.)

ing records of the activity of his abdominal, chest, and jaw muscles. The devices located on his jaw, chest, and abdomen are sensitive pressure recorders which produce a visible record of the form of the syllable movements and their grouping. The boy in this picture has some residual hearing which has been improved by a hearing aid. He now can be trained to improve his speech both by auditory and visual cues.

Another method of transforming speech into a visual pattern is by means of a *sound spectrograph*. Figure 13.12 shows a spectrographic record of the words "Lafayette, we are here." The sound pattern of the voice is analyzed into twelve different bands of frequencies from 0 to 3300 cps, and each band is represented in the visible speech pattern at a different height. The variations in density in the pattern represent varying intensities. It can be seen that the most intense parts of the sound pattern are at very low frequency levels in all syllables.

The sound spectrograph "breaks down" the sound pattern of a voice, by means of a frequency analyzer, into bands of sound frequencies. Each band causes a lamp to light up at a certain intensity, relative to the intensity of that band of sound frequencies. The light from the lamps shines through a slit and produces a glow on a slowly moving luminescent tape, giving a visible record of speech in terms of frequency bands and intensities. After a short time the glow disappears from the tape, making it possible for the tape to be used continuously.

In the picture of the word "Lafayette," each syllable unit is clearly defined. The third syllable, which is high pitched, is almost completely separated from the second, and the second from the first.

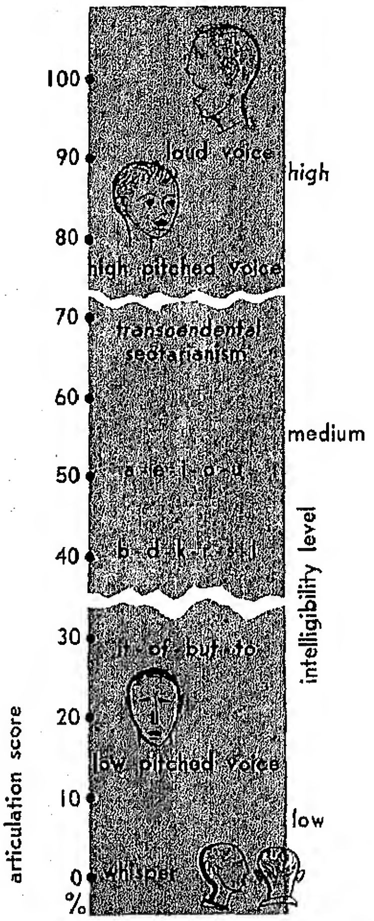


Figure 13.13. Articulation testing. Differences in intelligibility for different conditions of speech perception can be expressed in terms of an articulation score. The intelligibility level is higher for long than for short words, for vowels than for consonants, and so on.

One of the uses of visible speech records is to show a deaf child what his own words and syllables look like, compared with the speech sounds of others. This visual pattern helps him to learn normal speech coordinations by providing a continuous check on his efforts.

SPEECH PERCEPTION

The sounds of speech are perceived in two ways. First, they are identified as *semantic units*—that is, meaningful units of words, word groups, sentences, paragraphs, or stories. Second, these same syllable patterns are also perceived in terms of their distinctive sounds, which the linguist calls *phonemes,* and as having rhythm, accent, and cadence. Different languages and dialects vary in both their semantic and phonetic organization. Furthermore, the speech of different persons has definitive semantic and phonetic characteristics.

Articulation Testing. One of the primary psychological problems in speech perception is the efficiency with which different patterns of speech sounds are identified. In order to investigate such general problems, we use articulation tests, consisting of a number of standardized syllables, words, or sentences presented to a listener or a group of listeners.[4] The percentage of such standardized items correctly recorded constitutes the articulation score. Figure 13.13 describes differences in intelligibility for different conditions of speech perception, with the articulation score shown to the left as a percentage value and the relative level of intelligibility to the right. The whisper and low-pitched voice score low in intelligibility, as do short words. Another condition resulting in low intelligibility is the presence of masking noise. High articulation scores are found with loud and high-pitched voices, and for long words.

Articulation testing methods are useful in evaluating changes in quality, intensity, and pronunciation in speakers, especially in rating and training people who use their speaking voices in their jobs, such as radio announcers or switchboard operators. Such tests can be used to determine the effect of such psychological variables as verbal context and motivation on speech perception. They are also used to test various communication systems and to evaluate the effects of noise on audibility.

Audibility Curves. The efficiency with which we perceive the sounds of speech depends in part on the ability of the individual to detect and respond to sounds of different frequencies and intensities. A curve of hearing efficiency is called the *audibility curve* and can be determined by an *audiometer*. By means of the audiometer, sounds of different frequencies or words restricted to certain frequency ranges are presented to the listener. The intensity of each sound is lowered until it can no longer be detected, and then raised until the sound again becomes barely audible. The mean value of these two intensities represents the threshold of hearing.

The lower graph in Figure 13.14, obtained by testing an old man with defective hearing, shows a series of threshold determinations at frequency levels from 64 to 16,384 cps. Notice that we express the subject's hearing or *audiogram* in terms of hearing loss, or the difference between the obtained threshold values and a straight

line representing normal hearing. The difference in threshold intensities is expressed in *decibels*, which is not an absolute measure of sound intensity but a ratio between a sound of given intensity and a reference sound.

A decibel scale of sound intensity is established on the basis of a standard reference tone. One standard that is used is the sound pressure of a tone of 1000 cps which can barely be heard by the normal ear—that is, at threshold value. This sound pressure value at the 1000 cps threshold is called zero loudness. A sound 10 times this standard in intensity is said to have a loudness of 1 *bel* or 10 decibels; a sound 100 times as intense has a loudness of 2 bels or 20 decibels. Thus this loudness scale is a logarithmic one, and avoids the large numbers necessary if loudness were expressed in ordinary units. For example, thunder may have a loudness value of 100 decibels, which is 10,000,000,000 times the standard.

When we use an audiometer to test a person's hearing, we can determine first the audibility thresholds at different frequencies, and then by increasing the intensities can determine an upper limit for hearing where the very loud sounds produce pain. The upper graph in Figure 13.14 shows these thresholds for a normal ear expressed in decibels of loudness for the different frequencies. The range between the "threshold of hearing" and "threshold of feeling" or pain is known as the *area of hearing*. The upper curve stays fairly level for all frequencies, but the lower curve shows that the normal ear is more sensitive in the middle frequency range, being most sensitive to tones around 2000 cps.

The human ear is sensitive to an enormous range of sound intensities. Sounds

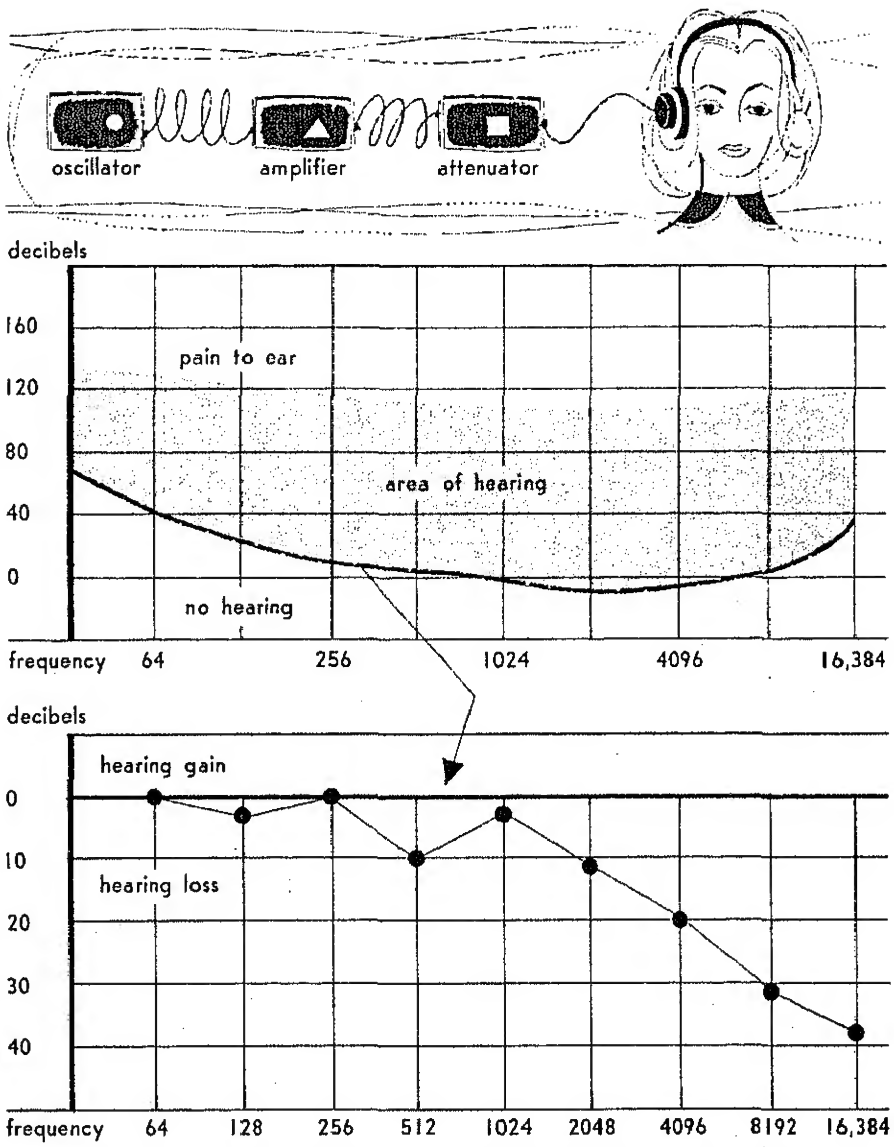


Figure 13.14. The area of hearing and an audibility curve. By means of electronic apparatus, we can determine the thresholds of hearing as a function of sound frequency. The area of hearing is defined by the absolute threshold and the upper threshold, the threshold of feeling or pain. The lower curve dips below zero because the decibel scale was established by using as a reference tone a 1000 cycle tone which could barely be heard. The lower graph represents a lower threshold or individual audibility curve as determined by an audiometer.

which produce pain are about 10,000,000,000 times as loud as barely audible sounds. Any sound that is heard, including speech sounds, is located in terms of frequency and intensity within the area of hearing. Audible frequencies up to about 10,000 cps are included in speech.

Speech Intelligibility. If we measure the loudness level of speech sounds at a point at which they barely can be detected as speech, we get a *threshold of speech detectability.* This threshold is roughly 10 decibels above zero loudness. Although the sounds can be identified as speech at this loudness level, the distinct syllables and words are not recognizable. As the intensity of sound is raised to about 25 decibels, we reach a point where the speech become barely intelligible—the *threshold of intelligibility.* In order for all (or nearly all) syllables and words to become intelligible, the intensity level must be raised to 50 to 60 decibels, the normal conversational level of speech.

The intelligibility of speech at any given intensity level of sound is a function of the rate at which it is spoken. Ordinary speech occurs at the rate of 150 to 200 syllables per minute or 100 to 125 words per minute. As the rate increases, intelligibility falls off, although the loss can be compensated for to some extent by increasing the loudness level. Actually, the speech rate must be increased greatly before much loss in intelligibility occurs.

The sounds of speech are complex patterns of frequencies which change constantly with the movements of vocalization and articulation. Studies of speech perception have shown that speech is still intelligible even though these sound patterns are modified greatly. Sound filters can be used to eliminate completely certain frequency bands. For example, all frequencies below 2000 cps may be eliminated, or all frequencies above 2000 cps, with the result that speech intelligibility is impaired, but not destroyed. Elimination of a part of the sound pattern does not, of course, change the basic syllable patterns and rhythms of speech. In other words, we recognize speech partly in terms of its rhythmic pattern as well as in terms of the audible phonetic pattern.

The sound pattern of speech may also be modified temporally by cutting out short segments at regularly spaced intervals. A tape recorder and playback device called a "speech compressor" make it possible to cut out small portions of a recorded sound pattern at constant intervals.[5] The recorded pattern then can be put back together minus the cut-out portions. It has been shown that speech and music are still intelligible even when shortened drastically. Recorded speech can be cut 25 percent or more without destroying its intelligibility, but if the cutting approaches 50 percent, recognition becomes difficult.

Our ability to perceive speech adequately despite marked deletion within the sound pattern is due to various factors. For one thing, perceiving words is just like perceiving other stimulus configurations. A few critical details are enough to give the impression of the total form or pattern. Thus we can cut out frequency bands from the sound pattern, or make regularly spaced temporal deletions, and still retain enough of the basic speech rhythm and enough of the articulatory sounds to make recognition possible. A second factor is that ordinary speech is very redundant; that is, it contains many more words than are actually necessary to convey the de-

sired information. Not only do we often repeat words, but due to the structure of language certain words are very likely to precede, fall between, or come after other words. We often can determine with considerable accuracy certain words in the flow of speech even though they literally are not heard.

WRITING AND READING

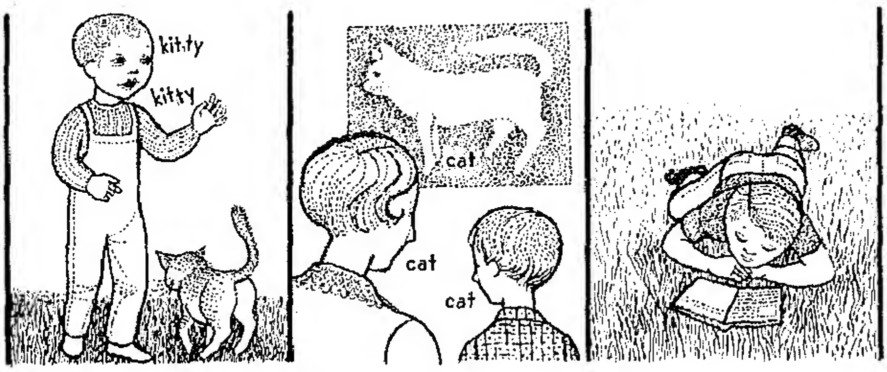
Spoken language is a facile, fluent form of behavior which enhances man's ability to think rapidly about objects and events in their absence. But spoken language has restrictions in accuracy and in providing a permanent record of what has been said. Written forms of language have given it greater precision and diversification. Like the growth of mathematics and music, language evolution has depended in part on the development and use of written and printed symbols. The written record of language is a permanent one on which each generation can build anew to refine verbal behavior semantically and scientifically and to extend thereby the linguistic patterns of thought further and further into the unknown.

Writing and reading bear the same psychological relation to one another as do speaking and listening. Both as behavior patterns and in terms of their historical evolution, they are correlated with speech and hearing. Our alphabet of written symbols, in contrast to pictographic and hieroglyphic writing, is derived from the syllable structure of spoken language. Normal progress in learning to write and to read depends upon the development of adequate oral speech.

To the children of every age, writing and reading have been difficult tasks. Between seven and eight years of average mental growth are required before the child can make adequate progress in learning these verbal skills. These activities were the major effort of education in older civilizations and they still make up a major part of elementary education today.

Organization of Writing Motions. Writing is learned as a manual skill, but once learned it can be carried out by other movement systems of the body. One can hold a pencil with his mouth or toes and write crudely but legibly. Also, writing learned with one hand can be transferred to the other. The complex motions of writing can be transferred from one part of the body to another about as easily as simpler manipulative motions.

In addition to being transferred from one movement system to another, writing movements can be varied in direction and orientation and still be legible, at least to some people. Most right-handed individuals are so accustomed to writing from left to right, right-side up, that they cannot easily shift these patterns. Some people, however, especially if they are left-handed or ambidextrous, can vary writing patterns in a number of ways, producing upside-down and mirrored writing. A left-hander often shifts his pattern of writing for two reasons. In the first place, ordinary left-to-right writing is awkward to perform with the left hand. Also, visual control of the written pattern is hampered because the hand partially obscures the writing as it moves along. Many left-handers turn the hand over so the pencil is held above rather than below the writing. Occasionally a left-hander may use mirror-writing consistently. Leonardo da Vinci wrote mirrored script all his life.



a b c

Figure 13.15. Learning to read. The actual process of learning to read, b, *depends upon the development of an adequate vocabulary,* a. *The early stages should be sustained by social motivation, but later efficient reading brings its own rewards,* c.

Children learning to write and to read exhibit in general much greater flexibility in movement organization than do most adults. Many of them can write with either hand and write mirrored as easily as normal script. Some of them also can read mirrored script with ease. This may be due in part to the fact that lateral dominance is not as clearly established in young children.

Right-handed adults become very rigid in their writing and reading habits. Letters and words have only one "right" orientation, and the rest are "wrong." However, it is possible to train adults in new patterns of writing. Filter-center operators in Air Force observation units learn to write mirror-writing with ease, using it to write information on glass windows to be read from the other side (see Fig. 14.15 in Chap. 14).

Learning to Read. To the young child, reading presents a new and very difficult task. The spoken word must now, in the form of strange and unusual marks, be "picked off" the printed page. We perhaps can appreciate the challenge of learning to read if we remember that it is only a few thousand years since language first was expressed in visual symbols. If it took our ancestors a million-odd years to produce something to read, there can be little wonder at the difficulties of the five- or six-year-old in mastering the principles that originally produced the written word.

Three main stages in learning to read are shown in Figure 13.15. Before actual reading can be carried on, the child must have developed an adequate oral vocabulary. This stage (*a*) is very important and too frequently forgotten. The more extensive the vocabulary and the more elaborate the vocal sentence structure of the first grader, the more rapid and certain will be progress in reading.[6]

In the actual process of learning to read, the child must learn to respond to a visual pattern of letters with a specific word. To help him, he has visual stimuli not only of the printed word but perhaps of a picture of the object, auditory stimuli of the sounds of the word from himself and others, and kinesthetic stimuli from speaking it and perhaps writing or tracing the letters. There has been much disagreement of late years whether reading is best taught by "sight" or "phonic" methods. In phonic procedures the child is taught the sounds of letters and letter combinations so that he can pronounce a word from its component parts. Teaching by the "sight" method is illustrated in Figure 13.15*b*. A word is learned as a unitary perceptual pattern directly related to the object it represents.

In actual practice many teachers find that reading is best taught by a combination of available techniques. The interest of the child can be stimulated originally by teaching words and phrases by sight methods. However, if a child is to learn to write and spell, he needs to recognize

all the details of letter forms as well as of word groups. Any combination of teaching aids which achieves the related goals of reading, writing, and spelling is acceptable. A good teacher can teach the child phonics and word perception simultaneously, and at the same time stimulate his interest in written and spoken language. In the last analysis, progress in reading depends upon progress in speech and the development of vocabulary.[7]

Adequate progress in learning to read depends upon more than training aids. The social motivation and reinforcement provided by teachers and parents are very critical at this beginning stage. Reading is a difficult task, and the child needs praise and reinforcement for his successes instead of scoldings for his errors. Serious retardation in reading can occur if the child's social and interpersonal atmosphere is unsatisfactory. However, learning to read eventually brings its own rewards. When the child develops his skill to the point where he can read stories and books instead of words and phrases, he finds new worlds to conquer (Fig. 13.15*c*).

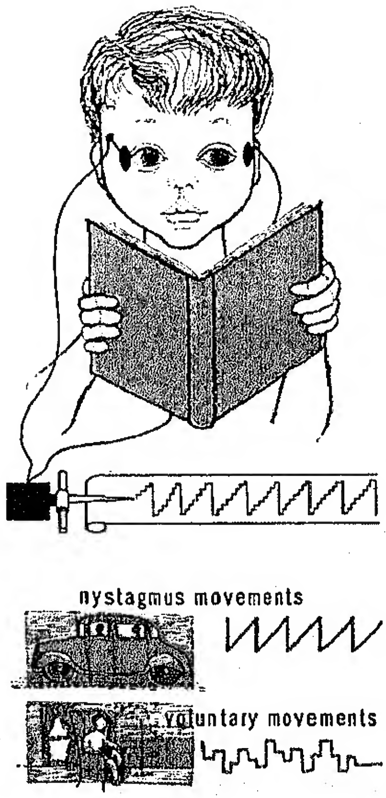
Eye Movements in Reading. Study of the movements of the eyes during reading reveals something of the nature of the reading process. Some of the steps in learning to read and in improving the speed and efficiency of reading can be understood in terms of the organization of eye movements.

Eye movements are recorded in two ways: by photographing the movements of a beam of light reflected from the cornea of the eye, or electrically, as shown in Figure 13.16. The electrodes taped beside the eyes pick up small changes in electrical potential which are produced as a result of eye movements. The step-wise record in the figure shows that the eyes do not move smoothly across a page in reading but jump from one position to the next. When the eyes are held steady, we say they are fixated, or are held in a *fixation movement*. The quick jump or travel movement is called a *saccadic movement*. In reading, the eye typically fixates first near the beginning of the line, then jumps to successive positions along the line, and finally jumps back to the beginning of the next line. A good reader shows a steady progression, with few fixations per line. A poor reader shows more movements per line and is apt to make regressive movements—that is, backward movements to pick up missed words.

When we look around at different objects in a room, our eye movements show an irregular pattern of fixations and fast jumps similar to the record for voluntary movements in Figure 13.16. However, if an object moves across the field of vision, the eyes can follow it in a slow *pursuit movement*, or moving fixation. If a series of objects moves steadily before the eyes, such as a landscape seen from the window of a moving vehicle, the eyes perform the movements called *nystagmus*. In this case, slow pursuit movements are followed by fast saccadic jerks, which return the eye to the original point. Unless special training is given, the eyes can perform slow pursuit movements only in response to the movement of a visual object (or with a stationary object, if the head is moved). In reading, there are no pursuit movements along a line of print; there are only fixations, when perception occurs, and saccadic jerks.

The average reader perceives 3 to 5 words during a single fixation, reads 200

Figure 13.16. Recording eye movements. Recorded eye movements during reading show a series of saccadic jerks across the page with return sweeps to the beginning of the next line. Perception occurs while the eyes are held still, or fixated. The lower records show the alternate pursuit and saccadic movements of nystagmus, and the random jerks and fixations of voluntary movements.



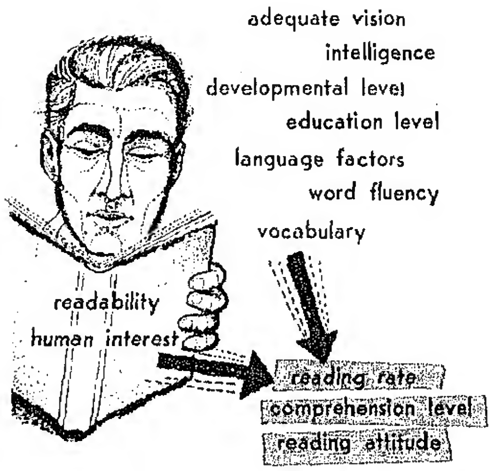


Figure 13.17. Factors in reading efficiency. Reading efficiency, as measured by reading rate, comprehension level, and reading attitude, is influenced by factors in the reader and in what he reads.

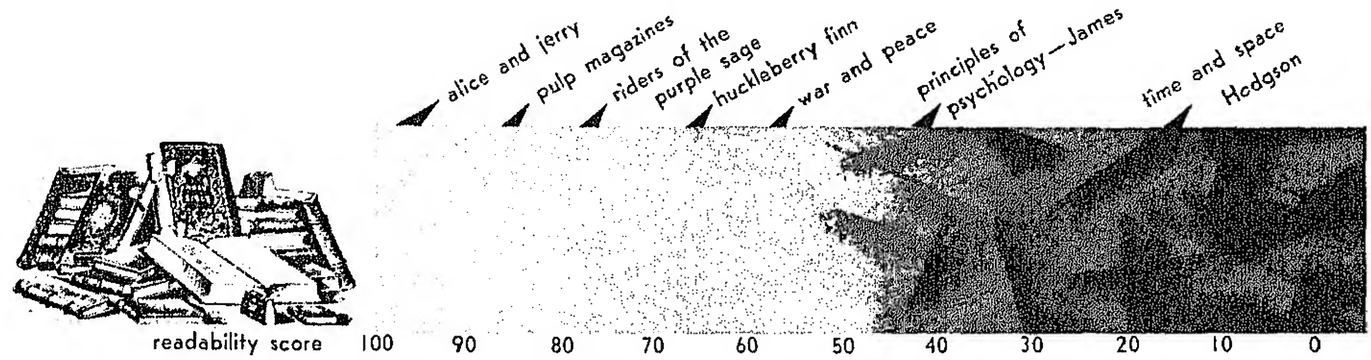
to 250 words per minute, and spends 5 to 10 percent of his total reading time moving the eyes. Good readers and those at high academic levels usually make fewer fixations per line of print and perceive more words per fixation. As we have said, good readers in general do not show as many regressive eye movements as do poor readers. In an experiment which required the reading of material of different levels of difficulty, the number of fixations and the frequency of regressive movements did not change appreciably from one level to another with poor readers.[8] However, good readers adjusted to more difficult reading material by making more fixations and regressive movements. The lack of appropriate adjustments in the poor readers indicated a mechanical mode of response to the words.

Reading Efficiency. An individual's proficiency in reading cannot be judged by any single measure. As a complicated pattern of adjustive behavior, reading must be evaluated in terms of several factors: reading rate, comprehension level, and reading attitude. Records of eye movements give us one measure of reading rate and the efficiency with which these movements are organized. However, the importance of reading to the individual lies not only in his speed, but in his comprehension of the material read and in his attitude toward reading as an activity.

Reading comprehension is measured by means of standardized tests. The individual is presented with a passage to be read, following which a series of prepared questions, covering the ideas and facts of the passage, must be answered. The percentage of facts and ideas correctly identified gives the comprehension level. Reading attitude in children can be judged by the total time spent in spontaneous reading, or time devoted to reading after an initial assignment is completed. Direct questions are also used to estimate the level of motivation in reading activity.

Efficient reading is determined both by the reader and what he reads. Figure 13.17 indicates that both individual factors and variations in reading material influence reading behavior, as measured by rate, comprehension, and attitude.

Three of the reader factors shown in the figure—vocabulary, word fluency, and language factors—are closely related. Vocabulary level might mean reading, speaking, or writing vocabulary, but what we call the recognition vocabulary is most closely related to reading skill. Language factors represent individual behavior patterns in using words, such as the length of sentences or the relative number of verbs or adjectives used in speech. Children and people of low intelligence, who show a relatively low level of reading proficiency, also use a disproportionate number of verbs and adjectives in their speech.[9]



readability score	100	90	80	70	60	50	40	30	20	10	0
syllables per 100 words:	123 or less	131	139	147	155		167		192 or more		
percentage of definite words:	50 or more	43	36	29	22		14		5 or less		

Figure 13.18. Measuring readability. Readability scores of different books as based on statistical characteristics of the reading material. (From Flesch, R. Measuring the level of abstraction. *J. appl. Psychol.*, 1950, 34, 384–390.)

Reading material should be suited to the reader just as a machine must be designed appropriately for the human operator. We all know that the child of eight would find it difficult to read the philosophy of Immanuel Kant. On the other hand, a normal adult has a low reading attitude for a steady diet of Alice and Jerry. In writing or selecting books, we must follow principles of human engineering that apply to all forms of adjustive behavior. Two measures of reading material are shown on the cover of the book in Figure 13.17: *readability* and *human interest* measures.

Readability is essentially a measure of difficulty of reading material, while human interest is measured by the percentage of personal words and sentences in the material.[10] Both measures are derived from actual syllable and word counts of samples of reading material. The human interest scale runs from 0 to 100, and is broken into categories labeled "Dull," "Mildly Interesting," "Interesting," "Highly Interesting," and "Dramatic." Examples of reading material which fall into these categories from "Dull" to "Dramatic" are scientific journals, trade magazines, digests, *The New Yorker*, and fiction.

One scale of readability is based on the number of syllables per hundred words and the percentage of definite words, combined according to a formula to yield a score from 0 to 100. Definite words are concrete words such as names, specific limiting adjectives, or finite verbs.

Figure 13.18 shows the pattern of readability scores with examples of books in each category, from very difficult to very easy. These categories were based upon a series of reading samples keyed to the comprehension level of children in school grades; that is, the actual readability score is related to standard reading samples of experimentally known difficulty. However, the correlation between readability scores and comprehension level for different reading samples is far from perfect. Readability in a broad sense depends upon factors far more subtle and complicated than the number of syllables per hundred words or concreteness of expression. The interests and motivation of the reader have much to do with readability, as do the physical characteristics of type and format, and the nature of whatever illustrative material there may be.

Measures of readability are used widely to adjust types of writing, such as news-

paper articles, magazine articles, business letters, and publications, to the level of the intended reader. They might be used profitably in revising such necessary literature as college catalogues and income-tax instructions.

Improving Reading. The average reader reads 200 to 250 words per minute. Superior readers may read 500 to 600 words per minute, or in surveying easy material may cover as many as 1500 words per minute. In contrast, poor readers stumble along, even on easy material, at 50 to 150 words per minute. Of recent years, there has been widespread interest in improving reading speed and comprehension in the normal adult reader. To cope with school or college, or the demands of many executive and administrative jobs, an individual must be able to handle large amounts of reading material.

An effective program for improving reading often starts with an attempt to change reading attitude. Many people look upon reading as hard work and have a "halfway" attitude toward it. To open the way toward reading improvement, the reader must be motivated to want to improve. Practice in speed reading with interesting material is the second phase of improvement. Reading-accelerator trainers, like that shown in Figure 1.1*h* are widely used. Practice should be regular and carried out for at least several months. Tests of speed reading in the normal reading situation are conducted periodically in order to measure progress and give knowledge of results. The third phase in improving reading is working on vocabulary and language factors. Not much can be done with older adults in this area, but high school and college students can make lasting improvements in reading by improving vocabulary and language habits.

Two questions are usually raised about the effects of reading training. What effect does an increase in reading rates have upon reading comprehension? And how long will the effects of the training last? In answer to the first question, it is known that reading rate can be increased, sometimes greatly, without any important loss in comprehension. It is this achievement that makes any effort to increase reading efficiency worthwhile. The permanence of reading improvement depends on a number of factors, especially on the use made of reading skill after the period of training. We would not expect an athlete or a skilled worker to remain expert in his specialty if he did not practice and perform regularly. Likewise we do not expect a three-month course in reading training to make a lasting effect on performance, unless the person continues his reading efforts and tries to maintain a high level of reading skill. If proper reading attitude is maintained, there is no reason to believe that good reading training cannot be of lasting value.

LANGUAGE AND MEANING

When we use or recognize words, we think we know what they mean; but what is the basis of the meaning of a word? The signs and symbols used in language are arbitrary and mean nothing intrinsically. This problem of the meaning of words can be approached in several ways. The field of semantics deals with it in terms of the study of words. The problem is handled also in the field of linguistics, which is the study of the structure of language. However, since meaning is an aspect of verbal

behavior, it is first of all a psychological problem.

The psychological approach to the study of meaning of language symbols and patterns starts with the relations between different verbal reactions and between verbal and nonverbal behavior. Speaking, listening, writing, and reading are all forms of behavior set within and derived from patterns of nonverbal behavior. Once a language system is developed, the words and symbols used are responses which are integrated with nonverbal perceptions, emotions, and other forms of response. At the same time, the verbal patterns, spoken or written, represent nonverbal responses. The meanings of verbal behavior illustrate the principles of multiple causation and interaction present in all adjustive behavior. Language is possible because two or more response patterns of the organism can occur to the same stimulus situation, and because two or more stimuli can give rise to the same response. A specific word is always associated with other verbal and nonverbal reactions which give it meaning.

The Semantic Differential. A recent experimental approach to the study of meaning attempts to set up scales in terms of which the meanings of words can be analyzed. The procedure is called the *semantic differential* because it differentiates the meaning of a particular word or concept from others.

A number of words were judged by a group of subjects in terms of a series of 50 pairs of adjective opposites, such as bad-good, rough-smooth, and so on. Each word then was assigned a place on a seven-point scale for each pair of adjectives. Figure 13.19*a* shows how the word "polite" was rated on six of the adjective-opposites scales. The result is a "profile" of the meaning of polite, which at first glance has nothing to do with its dictionary meaning. We see that "polite" means to most people something that is good, fairly relaxed, fresh, and strong. It has no general meaning on the rough-smooth or cold-hot scales.

When a number of words were rated in this way, it was found that the meanings varied mainly in three basic dimensions, which have been called evaluation, potency, and activity (Fig. 13.19*b*). Under this rating system, a word has, in addition to its specific dictionary meaning, an evaluative meaning (nice-awful, good-bad, clean-dirty), a potency meaning (strong-weak, hard-soft, heavy-light), and an activity meaning (fast-slow, sharp-dull, treble-bass). The evaluative meaning, ac-

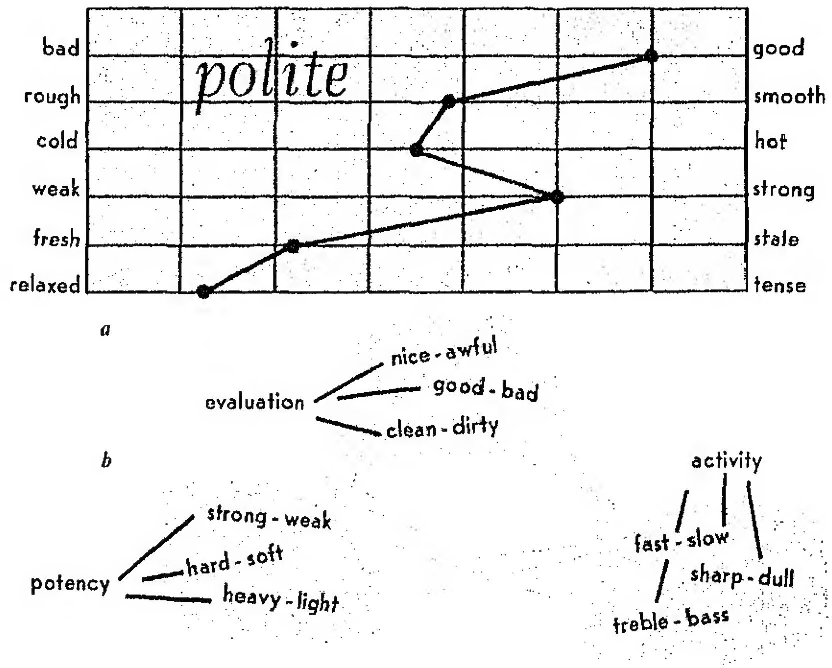


Figure 13.19. The dimensional analysis of meaning. When words were rated on an adjective-opposites scale, their meanings were found to vary in three basic dimensions: evaluation, potency, and activity. (From Osgood, C. E. The nature and measurement of meaning. *Psychol. Bull.*, 1952, **49**, 197–237; Osgood, C. E., and Suci, G. J. Factor analysis of meaning. *J. exp. Psychol.*, 1955, **50**, 325–338.)

cording to the experiment, is by far the most pervasive of the three.

This dimensional analysis of meaning suggests that there are a limited number of nonverbal factors which support and give meaning to our words. The three dimensions found in this experiment—evaluation, potency, and activity—might very well relate to motivation and emotion, strength or intensity of behavior, and activities or perceptual variables.

At any given time, any reaction made by an individual is defined by motivational-emotional variables and by perceptual-motor factors, that is, the organization of discrete responses in terms of the individual's perceptual reactions to his environment. These two sets of factors help determine the nature of the response, and also its strength or intensity. Verbal responses are similar to all other forms of behavior in their determination. Thus a verbal response has meaning in these three dimensions: motivation-emotion (evaluation), perceptual-motor (activity), and strength or intensity (potency). In addition, all behavior changes in time, because of the processes of maturation and learning. Like other forms of response, the meanings of words are not fixed, but are learned and can change according to changes in the individual.

Verbal Context and Meaning. Language meanings are not confined to single words, but emerge in groups of words and phrases. The meaning of a word can change according to how it is used—its verbal context. Sometimes a word has little or no meaning except as one part of a phrase or idea.

It has been shown, for example, that a single nonsense word can acquire meaning through use in familiar phrases and sentences.[11] Read through the following set of sentences in which the nonsense word *prignatus* is used, and see if you can derive a consistent meaning for it.

1. Boys sometimes prignatus their mothers.
2. Mary did not know that Jane used to prignatus.
3. Mother said, "Johnny, you should never prignatus your own mother."
4. You may prignatus someone but you will not get away with it often.
5. A good man who tells the truth will never prignatus you.
6. If Bob prignatus someone, he makes sure they don't find out.

If only one sentence is considered, the nonsense word might have several meanings. However, as we read more sentences, the possible meanings become fewer until the one most appropriate meaning emerges. The ability to derive the meaning of *prignatus* (deceive) from the set of statements depends upon the regularities in construction of phrases and sentences. Groups of words which constitute a phrase are learned habits of response with meaning. Thus in Statement 4 above, the words "get away" cannot be considered alone, but acquire specific meaning when the words "with it" are added.

The ways in which single words are combined to form meaningful phrases constitute the laws of grammar. Children learning to speak learn these regular procedures and only later—in language classes—learn the formal rules as summarized by grammarians. Because different combinations of words are used to convey many different meanings, we are able to communicate almost any idea or information with a very limited number of words. Although the English language contains

about 500,000 words, the number used in ordinary speech is amazingly small. A study made of a large number of telephone conversations found that a total of 80,000 different words were used, but of this total just 737 words made up 96 percent of the conversations.[12] Thus practically everything that was said in these conversations was communicated by different combinations of just 0.2 percent of the words in the English language.

These versatile English words which combine to convey so many different meanings are for the most part the common, short words of our language—the prepositions, articles, conjunctions, and the nouns, verbs, adjectives, and adverbs that correspond to the most familiar objects and events in our experience. Many of these frequently used short words have multiple meanings (e.g., bat, run). Their specific meaning in a phrase or sentence depends on the context. The longer words in the language usually have much more limited meaning and consequently are less useful.

Our choice of words and the way we use them in sequences depends in general on the structure of language as we have learned it. Accordingly, once we have started a sentence or phrase with a certain sequence of words, the number of possible words that can come next is limited, due to the structure of language and our verbal habits. To some extent, then, our choice of words is predictable.

However, one fascinating aspect of verbal behavior is its unpredictability. There is a principle of indeterminacy in the use of language. We never know exactly what other people are going to say—rarely what we ourselves are going to say. The ability to create new sequences of words, in sentences and paragraphs, poetry and prose, is one requisite of literary talent. Who can say when another word artist like Shakespeare will appear? Individual artistry and effectiveness in the use of words is based —as are other forms of art—on meanings which conform to individual adjustive experience. However, these individualized patterns of words can be used to communicate with others insofar as they conform to general human experience and social values. Language and language meanings thus combine two outstanding features of behavior: the systematization of activity according to social patterns, and personalized experience in adjusting to the environment.

Understanding the unpredictability of speech is a challenge to all students of behavior. Verbal reactions are not stereotyped responses to specific stimuli. We acquire our knowledge of words and their meanings by learning; yet we are constantly combining words in sequences that we have never used before. These new verbal patterns not only have meaning to the person uttering them, but are perceived immediately by the listener. Furthermore, in the complementary interplay of verbal behavior, sequences of words lead to further new sequences, carrying the participants on and on into unexplored areas of perception and thought.

The Psychological Basis of Meaning. In the face of limited facts, what is a good preliminary answer to the broad problem of the meaning of language symbols? The problem and its partial answer can be formulated as in Figure 13.20. Where does a particular language symbol, such as the word "man," derive its meaning? It has no absolute, only relative, meanings.

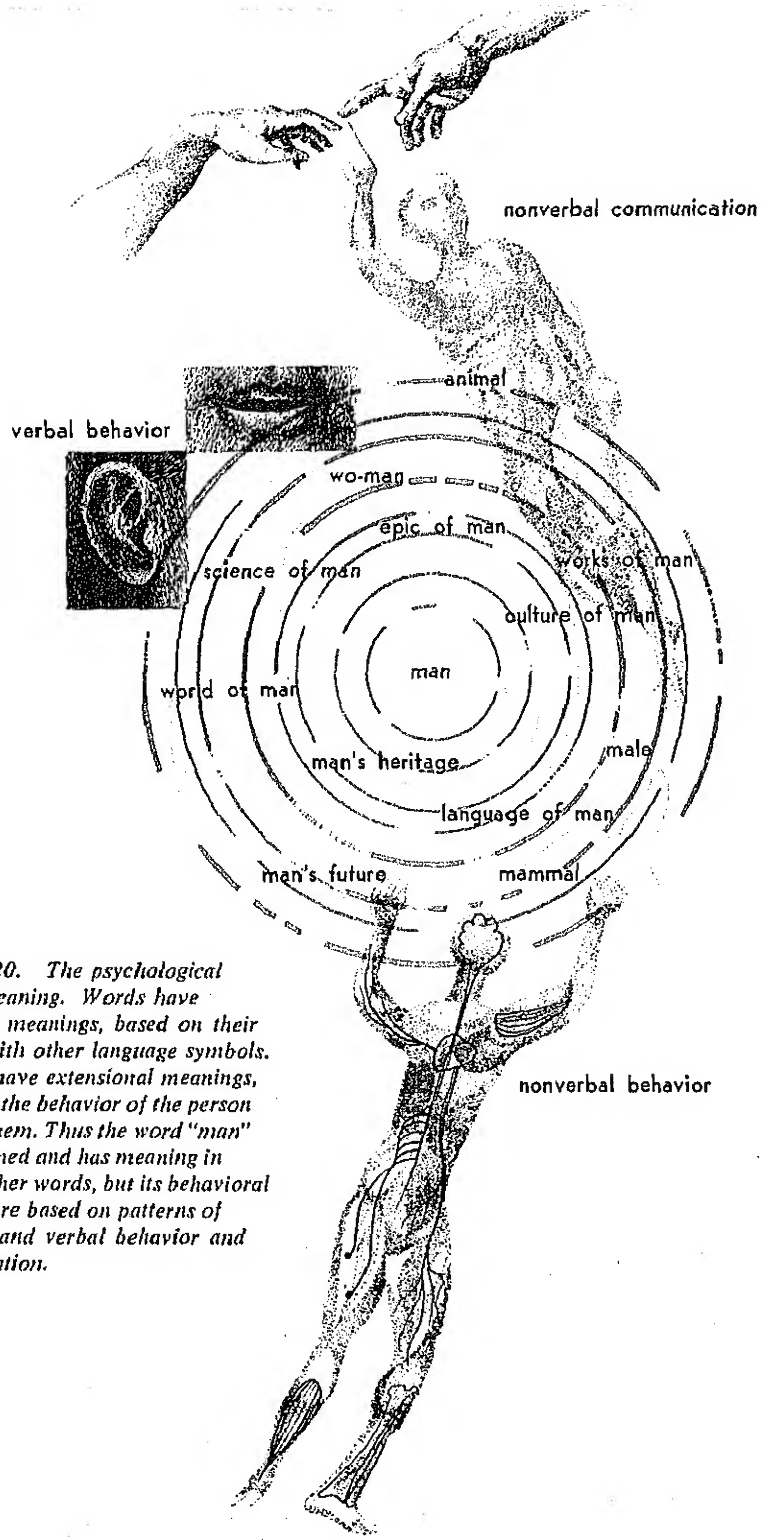


Figure 13.20. The psychological basis of meaning. Words have intensional meanings, based on their relations with other language symbols. They also have extensional meanings, in terms of the behavior of the person who uses them. Thus the word "man" can be defined and has meaning in terms of other words, but its behavioral meanings are based on patterns of nonverbal and verbal behavior and communication.

First, the relations between the word and other language symbols can be used to describe its meaning. A dictionary defines a word only in terms of other words. This is its *intensional* meaning. The words inside the circle in Figure 13.20 are examples of verbal symbols or intensional meanings which help define "man." The second type of meaning behind the word "man"—its *extensional*, or behavioral meaning—is illustrated by the figures.

There are three main sources of behavioral meaning. The first of these is in verbal behavior itself—in the motions of speaking, listening, writing, and reading. Every word that we use or recognize, and every one of its related words in definition and in context, is represented by a precise, controllable motion pattern. The movements used in producing this word or in reading or hearing it involve feedback signals which give it a meaning different from all other words.

The second behavioral basis of meaning is derived from the activities of nonverbal communication—that is, the expressive movements of gesture, of drawing, of grimacing, of emotion, and of posture. All word concepts, even the most elaborate, have nonverbal communicative actions in terms of which they can be expressed. Drawing and charades are good examples of the broad scope of this overt behavioral basis of word meanings.

Finally, all the words that we use derive meaning from nonverbal behavior. We ordinarily think of words as symbols used to label objects or events. Thus the word has meaning by virtue of its association with perceptual responses that the individual has made to the object or event. The fact that this association is learned, that the word used may be arbitrary, doesn't

detract from the meaningful relationship established. The scope of association of language symbols with the nonverbal behavior of the responding organism goes beyond perceptual reactions. Words have meaning because they relate also to motives, interests, postures, chemical states, motions, emotions, and in fact to all forms of activity of the organism.

The nonverbal meanings of words are established through the procedures of learning, generalization, and so forth, in the same way as other forms of response. For example, if an individual has learned to respond emotionally to an object, he will generalize that response to the word which signifies the object, and to synonyms of the word. Or, if he learns to respond to the word first, the response will be generalized to the object when it is encountered. Thus a child might respond fearfully to a snake the first time he saw one, if he had learned that response in relation to the word.

The procedure known as semantic conditioning shows how nonverbal responses are generalized from one word to another. For example, if a conditioned salivary response is established to the verbal stimulus "style," it will generalize to a word similar in meaning, but entirely different in its auditory sound pattern, e.g., "fashion."[13] The same sort of effect can be demonstrated in the lie-detector situation. A subject who responds emotionally to the name of an object which was present at the scene of his "crime" will probably show the same emotional response to the name of a similar object.

The power of language, spoken and written, derives from the action equivalents of words—their behavioral meanings as they are used in the angers and hate of fighting and war, in the tenderness of love, in politics, in fear of catastrophe, in perceptions of events around us. Words can injure. They can excite. They can soothe. They can prohibit. They can tie the bonds of love and affection. And they can help heal those who are ill. We properly marvel at the hundreds of thousands of words in our language and the billions of combinations in which they can be used. At the same time, we should remember the untold numbers of action equivalents of these words, which provide the primary origin of meaning. The marvelously organized perceptions of the world and of events in the body are the foundation of verbal behavior. These two complex behavior systems—knowledge of words and perceptual-motor action—are interdependent. Neither could evolve or exist without the other.

SUMMARY

Verbal behavior is one form of communication, which also includes many nonverbal forms. A language is a set of consistent and meaningful symbols—pictorial, gestural, or verbal—used in communicative behavior.

Nonverbal communication is closely integrated with verbal, and establishes a climate for social interaction.

The functions of language include pointing to or signaling objects or events, aiding in perception, and facilitating abstract thought. The social use of speech involves behavioral interaction between speaker and listener.

Human speech is made up of syllable units, characterized by vowel quality. Syllables may be vocalized through the action of the larynx, and may be released and arrested by consonant articulations. The

rhythm and patterning of speech is coordinated by movements of the larger chest muscles, the abdominal muscles, and diaphragm.

In hearing individuals, speech is directed and controlled primarily by auditory feedback from the speech sounds. In the deaf, other methods of control must be used. Visible records of speech aid in training deaf children to speak normally.

The efficiency with which speech sounds are perceived can be tested with articulation tests. Higher articulation scores are obtained for loud and high-pitched voices than for soft and low-pitched, and for long words than for short. Poorer scores are obtained whenever masking noise is present.

The area of hearing represents the loudness range for all audible sounds between the thresholds of hearing and of pain. Speech is detectable at about 10 decibels above zero loudness, and barely intelligible at about 25 decibels above. Normal conversational level is about 50 to 60 decibels above zero loudness. Parts of the frequency pattern or temporal pattern of speech sounds can be eliminated without destroying its intelligibility. Enough critical details remain to make perception possible.

Children learning to write often use upside down or mirrored writing. This transferability of writing movements sometimes persists in ambidextrous or left-handed individuals, for whom standard right-handed writing may be awkward.

Learning to read depends on an adequate vocabulary and effective motivation and reinforcement. Improving reading efficiency in an adult also depends on a good reading attitude and regular practice.

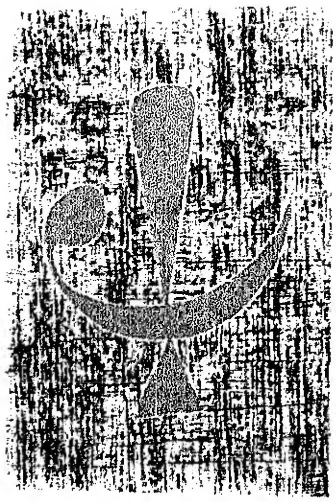
Eye movements in reading consist of a series of alternate fixations and saccadic jerks. Perception occurs during fixations.

Reading efficiency can be measured by reading rate, comprehension level, and reading attitude. Efficient reading is a function of both individual factors and the nature of the reading material. Two measures of reading material are readability and human interest.

When words are rated on adjective-opposites scales, they are found to have meanings which vary principally in three dimensions: evaluation, potency, and activity. These dimensions seem to correspond to the behavioral variables related to motivation, intensity or strength, and perceptual-motor action.

Language meanings are not confined to single words, but emerge in groups of words according to the context in which they are used. The structure of language determines our choice of words to some extent, but individual factors interject an element of unpredictability based on personal word habits and meanings.

Words have both intensional and extensional or behavioral meanings. The sources of behavioral meanings lie in verbal behavior, nonverbal communicative behavior, and general nonverbal activities of the organism.



PART 3. PERSONALITY

When we take up the study of personality, we are turning from a description of the generalities of human behavior to an attempt to understand the specific nature of the individual. Personality represents the organization of adjustive behavior within the social environment. It emerges in the interaction between the reacting organism and the structures and characteristics of social groups. The social environment is perceived by the individual in terms of people and the roles they play in society—roles that vary in complexity, function, and cultural value.

The standards of the social environment furnish the criteria by means of which we judge the abilities and personality of the individual. The measurement of individual differences in personality characteristics, intelligence, motor skill, and other abilities is both a theoretical and a practical problem. To understand how an individual develops his unique personality, we need to be able to describe his personal attributes in quantitative terms, and to relate them to social norms. The practical problem is to make the best use of each individual in a complex society. In order to help each person adjust to the requirements of social roles, we need reliable and valid tests for the description and prediction of psychological events.

In every society there are individuals who for various reasons do not make a satisfactory adjustment to the stresses and conflicts that mark human life. Helping the disordered individual requires the application of all our knowledge of general behavior and individual differences, along with special techniques of psychotherapy, the use of drugs, and other physiological procedures. The scientific study and treatment of the behavior disorders complements the general study of behavior; all fields of psychology advance our knowledge of organization of response in the individual.

CHAPTER 14. SOCIAL BEHAVIOR

Society is both an environment and a *form of behavior. As an environment, it* takes two forms, the actions of people and the physical structures of civilization and culture. As behavior, it consists of person-to-person responses and group activities.

In both lower animals and in man, social behavior occurs on four levels, as illustrated in the photographs above—social aggregations, interpersonal behavior, group activity, and culturally defined action. The social aggregation is a collection of individuals engaged in common behavior who do not interact in any systematic way. Pigs eating in a barnyard, buffalo collected together on a plain, or very young children playing near one *another, but alone, are all social* aggregations. Activity in social aggregations differs from other forms of social behavior in that it is essentially individual in character although taking place in the presence of others.

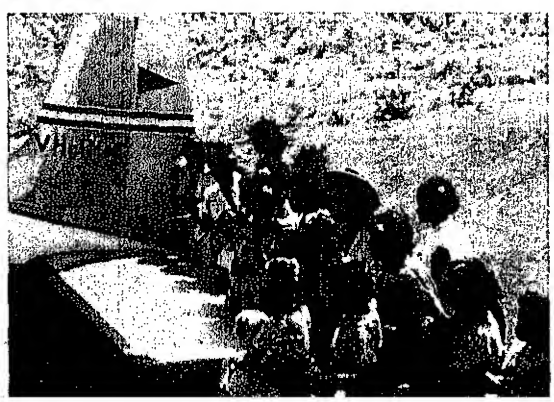
The simplest form of true social behavior is interpersonal in character. The interaction between two individuals leads to an adjustment which is related to action of both participants as well as to the environment in which it occurs. Mother-child behavior, sex behavior, and fighting are forms of interpersonal adjustment.

When three or more people interact, we have a pattern of group behavior. Two

a

b

Figure 14.1. Members of a primitive culture. Australian aborigines are biologically similar to all other men, but show many behavioral differences due to influences of their physical and social environments. a. *Preparations for the rites of puberty.* b. *A group of women before a primitive hut.* c. *Children of the bush.* d. *Children under Western influence.* (Courtesy Dr. Peter R. Morrison.)



levels of group interaction are free social action as we see in the play of children, and culturally determined group activity, regulated by the institutions, laws, and traditions of society. At this level the individual adjusts his response according to the immediate social group as well as the established social norms and the standards of his culture. When the individual goes to church, drives his car on a city street, or attends a college, he is adjusting in terms of culturally patterned activity.

Individual and Group Interaction. The adjustment and personality of the individual both *define* and *are defined by* social and cultural factors. The structures of society reflect the psychological make-up of the people who have designed them. Culture is itself a product of human personality, adjusting to its physical environment. Just as the bird's nest and the bee's hive are structured according to the particular make-up of these animals reacting to their environment, society mirrors the behavioral patterns of the individual as a psychological and physiological organism. Our homes are made to accommodate families, our clothes to fit the body, our tools to be used by a five-fingered hand.

On the other hand, each individual is influenced from the moment of birth by the structure of his social and cultural environment. His personality and patterns of adjustment are defined as much by the standards and demands of society as by his biological nature. Furthermore, the cultural stimuli that play so large a role in individual development may have originated hundreds or even thousands of years ago in earlier epochs of man's social

existence. There is an unbroken continuity in our language, in our use of pictures, in our religious rituals, and in our social attitudes going back to the social activities of Stone-Age man.

Although man himself has changed little biologically since his emergence as a species, he has developed many distinctive societies and cultures over the face of the earth. The developing individual conforms to his biological heritage, but he also conforms to the social milieu into which he was born. Thus the social, cultural, and technological evolution that has occurred from Stone Age society to our own has seen a corresponding evolution in patterns of personal adjustment.

We can get an indication of some of the basic similarities as well as some of the striking differences in human societies by comparing a primitive culture with our own. Figure 14.1 shows a series of photographs of Australian aborigines, members of the most primitive society which exists today. The Australian natives have lived, and many of them still live, in a Stone Age culture. Their barren existence and primitive economy have led some to believe that they are a biologically inferior race. Yet in their contacts with modern Australia, they show themselves capable of assimilating patterns of Western culture and acquiring modern mechanical skills when necessary.

Like all other human cultures, the Australian peoples have developed a complex language and a complicated philosophy or religion. Their social existence is organized in terms of the family and the tribe. They have laws, customs, and taboos to regulate all of the important events of life. Similar in their biological make-up to all other men, these primitive peoples, isolated for so long a time from the main currents of civilization, are also similar in their social and communicative interaction.

The first picture in Figure 14.1 shows men preparing themselves to take part in rites of puberty, when boys are initiated into tribal manhood. They are applying tufts of cotton to their skin. The next picture is of a group of women seated before one of their primitive huts. The last two pictures show first a group of children who live in primitive conditions, and another group, combed and dressed and gathered about an airplane, who have come under the influence of Western civilization.

These two groups of children suggest how society can structure the life of the individual. If the children were to continue as they have begun—one group in tribal society on the barren central plains of Australia and the other group in urban Western society—as adults they would be cultural strangers. Not only would the patterns of their daily existence be different—the food they eat, the clothes they wear, their habits of personal cleanliness, their formal knowledge and skills—but their patterns of motivation would be quite dissimilar. In this chapter we shall try to describe how the social environment sets the course of adjustment and defines the needs, goals, and aspirations of the socialized individual.

THE STRUCTURE OF THE SOCIAL ENVIRONMENT

Human personality is differentiated within a framework of social behavior. When persons organize themselves into groups and assume special roles in these groups, the fundamental differences be-

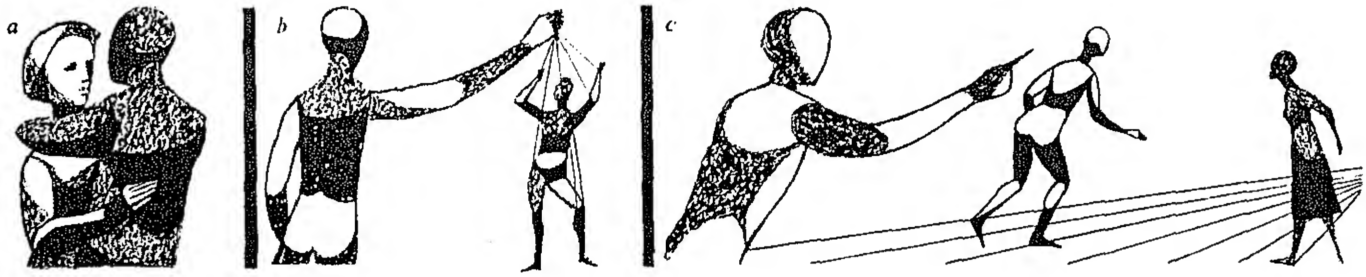


Figure 14.2. Forms of interpersonal roles. a. *The true interpersonal role involves give and take between two people, either of a positive or a negative nature.* b. *The social puppet is controlled by another.* c. *The social messenger serves as an intermediary between other people.*

tween individuals are accentuated. Individual differences are revealed in differential social adjustment to the organized structure of society.

There are many different possible positions for the individual in society, each of which defines a social role, such as leader, teacher, worker, parent, and so on. Each individual is better fitted for some roles than for others, is more successful in some positions than others. When we speak of "personality," we refer both to the life roles of the individual in society and to the way in which he fulfills them.

As man's social environment has evolved from primitive levels, new functions and roles for individuals have differentiated within it. In addition to the primary roles of male, female, and offspring in the primitive family group, special social roles have arisen—watcher, hunter, food gatherer, leader, builder, priest, soldier, teacher, doctor, housewife, and so on—to include the multitudinous facets of civilization. Social roles are patterns of social behavior requiring special abilities or traits on the part of the individual.[1]

Interpersonal Roles. Some of the forms of person-to-person behavior are shown in Figure 14.2. The most fundamental of all these roles is the positive interpersonal relationship of husband to wife, mother to child, friend to friend, worker to assistant, doctor to patient, counselor to client, and so on (*a*). This true interpersonal role can also be negative in character, as in the case of two fighters or two opponents in a verbal duel. These roles hinge on a balanced kind of interaction, a give and take between the two people involved. They have both a private and a public status; that is, they are social but still retain the privacy and secrets of individual life. Lovers keep their mutual interests to themselves, just as two conspirators may.

In organized societies interpersonal roles sometimes become modified and distorted, so that a true interaction does not occur between the two parties. We can use the terms "body handler" and "social puppet" to designate impersonal roles of this sort (*b*). The body handler is the impersonal carrier of people, the prison guard, or the "tough" cop. The social-puppet role is that of the "slave" or "prostitute" who is dangled or subjugated by force or through some meager consideration. In some societies, women or children are placed in the category of dependent social puppets.

A role that shows at the same time interactions with individuals and with a group is that of the "social instrument,"

or messenger. The social instrument interacts with more than one person, but these interactions take place at different times and do not influence one another particularly. The postman, the garbage collector, the newspaper boy, are social messengers. They interact with their superiors and with the people they serve, but do little more than convey materials or private messages between these different people.

Group Roles. In addition to interpersonal roles, the ordinary individual has many roles defined by his channels of activity in groups. Some adults do little more in society than carry out their parental and work roles. Others fulfill many other roles. They help in community projects, belong to clubs, serve as leaders in various enterprises, and enter into a wide scope of activities. Group roles vary in several ways, in their complexity, in their social function, and in their cultural significance. Each of these variables helps define the role to the individual and to the group.

Levels of complexity of group roles. Some social roles, such as executive or leader, are very complex and demanding of individual ability, while others, such as a yard man or a child at home, are quite simple and can be fulfilled even by a person seriously retarded in intelligence. Social behavior is organized first of all in terms of the psychological complexity of social roles.

The simplest type of group behavior is the membership role—in a club, a work team, or a family group. How does this primary group role differ from interpersonal behavior between two individuals? The three people shown in Figure 14.3*a* are a family group, the wife, her husband, and her sister. The wife shows an essential feature of all group behavior in her personal conduct in the presence of both her husband and her sister. As a matter of daily habit she will undress in the privacy of her bedroom when her husband is present. She would also undress in the presence of her sister, were they alone. But she will not undress before both her husband and her sister. In this family group she does not react to her husband alone or to her sister alone, but to the relation between the two. It is this relative reaction that distinguishes group from interpersonal behavior. The speaker before an audience, a mother caring for her family, an executive making decisions for his firm, are all responding in terms of the relations between members of the groups involved. This group reaction makes the six-year-old a different boy when he is with his mother and teacher together as compared with his reactions to his mother alone or his teacher alone.

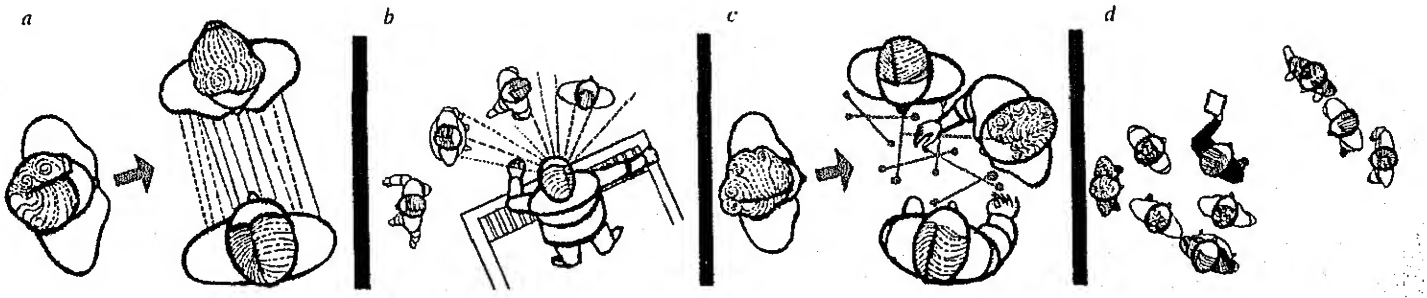
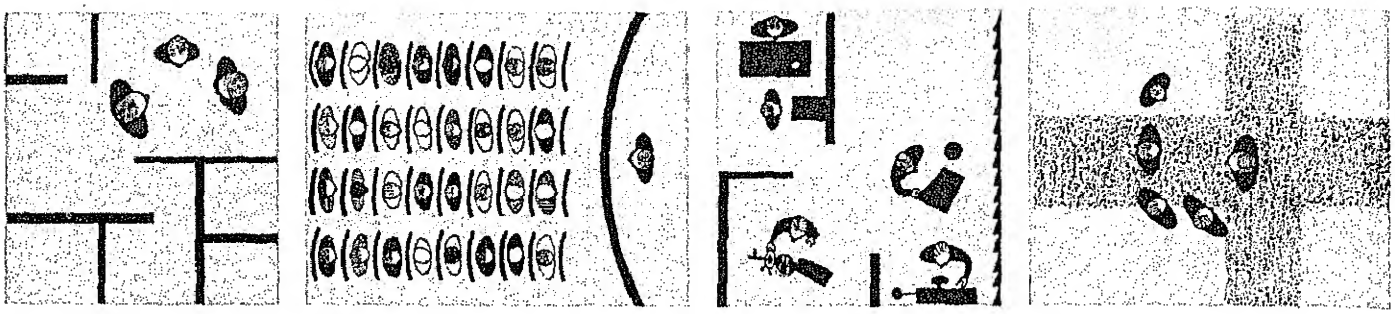


Figure 14.3. Group roles of different levels of complexity. a. *The members of a group react according to the interrelationships between other members of the group.* b. *The impersonal role of a social observer.* c. *The human relator is a social catalyst, promoting social activity in a group.* d. *The leader combines human relations functions with member and observer activities, as well as decision-making actions.*



a b c d

Figure 14.4. Functions of group roles. a. *The family role.* b. *The audience role.* c. *The work role is the main channel for personality organization in most adult lives.* d. *Fraternal roles serve many recreational activities, as well as service and religious activities.*

The second level of complexity in group behavior is the role of the social watcher or observer (Fig. 14.3*b*). The scout, the spy, the newspaper reporter, or the social scientist observes people in groups and interprets and reports what they do. The observer interacts with the people observed in only a limited way. He remains coldly or objectively aloof, as, for example, the experienced drama critic at a first night. This impersonal group role is part of the work of the artist, of the author, of the policeman, of the judge, and of the teacher or supervisor.

The third level of complexity we are going to call, for want of a better word, the role of the human relator—that is, having to do with human relations. We might think of this role as that of a social catalyst, a person who promotes and speeds up activity among people in groups, like the hostess shown in Figure 14.3*c*. The parent of several children, the salesman, promotor, supervisor, public relations expert, or the team coach is in part a social catalyst. All superior social roles, whether they demand leadership activities or not, involve human relations functions.

At the fourth level of complexity is the role of social leadership (Fig. 14.3*d*). Two characteristics of leadership distinguish it from the human relations role. Leaders make decisions for their own group, and they represent and act for *their group in relation to other groups.* Thus the leader role combines human relations activities, social observations, and membership with decision-making actions.

The executive or manager is a specialized leader. The executive in an industry must not only know people and react in terms of their needs but he must also know the business and its operations. A popular but unsound notion today is that executive ability is nothing but a matter of human relations. The leader of a free-roving band may not need to know much more than his own people and the terrain that they follow, but a leader of an orchestra must know music. Much the same is true of the executive leadership in industry or government.

The complexity of social roles is related decisively to differences in personality. Only individuals of superior intelligence and communication skills can fulfill the more complex group roles. Thus the organization of the social world constitutes the machinery by which relative levels of individual and social skill are known and recognized.

Functions of group roles. Group roles also differ in their function in the social world as well as in their complexity. Just as the individual organism differentiates and integrates its functions, society also divides its labors and interrelates them in particular ways. Functional social roles, such as family, work, and audience roles, are divisions of labor to fulfill the needs of the group and its members. Functional social roles evolve in society to obtain food, to eliminate wastes, to achieve communication, to rear children, to evolve means of dealing with enemies and catastrophe, and so on.

The family role is shown in Figure 14.4*a*. The social activity of the family centers around more than rearing children. It involves gathering and supplying food, obtaining and building protective structures, securing clothes, carrying out reproductive activities, and caring for and educating children. Family roles vary in relation to the family's position in society and its economic level.

Audience roles serve as the main communicating and organizing machinery of society (Fig. 14.4*b*). Schooling, religion, artistic and literary culture, and political and other social action are promoted primarily by the interplay between priests, teachers, or leaders and their audiences.

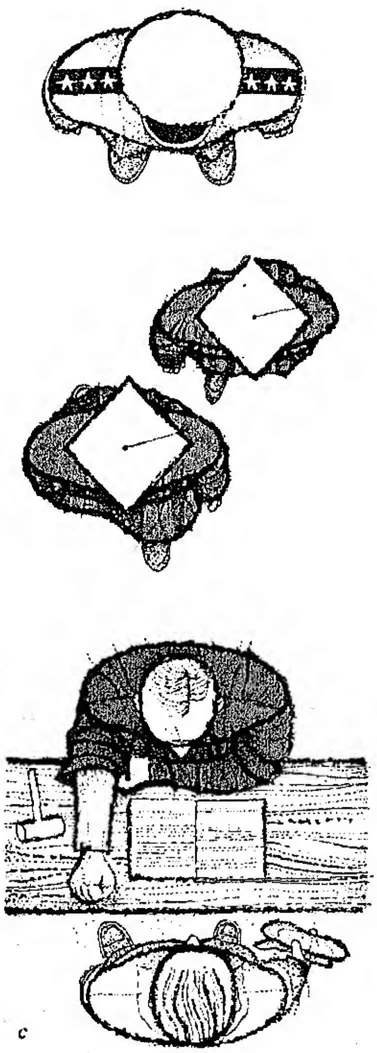
The economic, building, and distributive activities of society are organized around work roles (Fig. 14.4*c*). In the primitive family group, work and family life are identical. In modern urban society, these roles are sharply separated. The wife and children of a city dweller may never see his place of work, and may know next to nothing about his job. There are about 65,000,000 working people in this country who perform some 20,000 to 30,000 different types of jobs. Each of these types represents a different functional role. Whether it is simple or complex, the distinctive work role is the main channel in which most adult personalities are organized and expressed.

Fraternal roles are membership roles organized in terms of particular individual and group motives: protective functions, hobbies, service work, religious activities, and so on (Fig. 14.4*d*). Recreational activities often are organized around fraternal groups.

Another type of functional role is a community role, through which individuals perform some service to the community distinct from family or work roles. In simpler societies than ours—for example in the early days of America—the guarding and protection of the group were functions of community roles. We still see such groups as volunteer fire departments or sheriff's posses which perform these community functions. Philanthropic, communicative, and political activities also are carried on in part by community roles.

Cultural values attached to group roles. We have seen that the significance of a social role is due in part to its level of complexity and to its function in society. There is still a third way in which a role can vary that helps to determine its importance to the individual and to the group. The make-up of society in terms of its physical and technological status, the level of its scientific knowledge and artistic achievements, and the forms of its customs, rules, and traditions determines certain cultural values which attach to different group roles.

Some of the cultural variables which help to define roles are illustrated in Fig-



c

Figure 14.5. Cultural significance of social roles. a. *Some social roles are accorded social power beyond that inherent in the role.* b. *Ritualistic functions attach significance to some roles.* c. *Those who uphold the established order and guide the development of the new are accorded great respect.*

ure 14.5. Societies or cultures attach, by custom and tradition, social power to certain distinctive roles over and above the power inherent in the role. Thus, people in some positions exert social influence in all of their dealings with other people because of the cultural significance of their functional role. The three-star general shown in Figure 14.5*a* is accorded a certain measure of such power even in our own society. In time of war his power, both explicit and implicit, increases. Power also attaches to such roles as those of judges, priests, and high government officials. Most societies also accord social power to those individuals who possess wealth. Whether money is earned honestly or dishonestly or inherited, it helps to define the social role of the individual who has it. Some of the physical trappings of our society attach power to social roles. Our communication media—newspapers, radio, television, and motion pictures—greatly enhance the roles of the participants who are constantly in the public eye.

The group functions of society involve a certain amount of ritual which because of its historical or traditional significance serves to increase group solidarity. Some social roles are concerned mainly with carrying out ritual—in churches, lodges, courts, and the like. Other roles take on special significance at times in connection with ritualistic procedures. University faculties confirm their social position from time to time by donning caps and gowns and carrying out centuries-old procedures (Fig. 14.5*b*).

The social roles which carry with them the responsibility of maintaining the rules of the group, upholding law and order, are usually accorded great respect (Fig. 14.5*c*). Legislators, judges, religious functionaries—even the arbiters of the rules of etiquette are important to society in maintaining the old order and guiding the development of the new.

Social Status. In the social structure, *status* is sometimes used to refer to the position occupied by a person relative to the needs of the group. In a somewhat different sense, status refers to the prestige value of a position. Each individual has a certain status in his own community as well as in each group with which he is associated. The respect accorded a person by his fellows, his influence in community affairs, his standing at the country club, church, or at the bowling alley, are due in large part to the social roles he plays.

The complexity, the function, and the cultural values of roles all are important in determining prestige. A leader is generally accorded more respect than a member. However, an individual who is simply a member of his work group may be a leader in church or other activities. In addition, society attaches higher values to some functional activities than others. In our own society, we honor professional people highly. In different cultures at different times, high social status has been enjoyed by priests, scholars, and military men. If a person carries out more than one functional role, he may achieve higher status with one than with another. An ordinary workman may carry out a community role—recreational work with children, for example—or have fraternal roles in clubs, recreational groups, and so on, which contribute to his community prestige far more than does his work role. Finally, the cultural values of

which we have spoken are usually closely related to prestige. The social power inherent in a position or in wealth, the respect given to ritual, law and order, are all important in determining status. But power roles or ritual roles cannot define prestige alone. The person with power may be despised behind his back, while the stickler for outmoded ritual may be privately ridiculed.

Social prestige is due to the combined effects of all the roles an individual plays. It cannot always be predicted by an outsider. While a person's status is not impervious to change, it is likely to remain fairly constant over the years, due in part to what we might call *social generalization*. Social roles and their prestige value are important not only to the person who plays them but generalize to some extent to members of his family, his friends and associates. Social generalization accounts for the prestige value of being a member of the "best families," the town's "leading citizens." In a stable, well-organized community the family name is almost as important as any other factor in determining status. A son of one of the "old families" enjoys the highest social standing, even though he may have little wealth, mediocre abilities, and be next to useless in his functional roles.

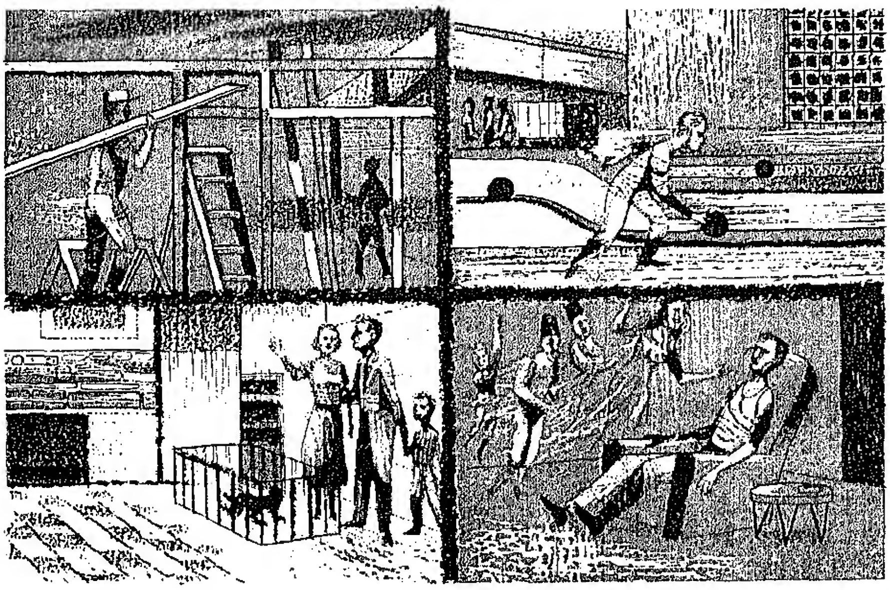
Prestige generalizes almost inevitably to the wives and children of men playing significant roles. The wife of the three-star general, or the governor, or the company president finds her social status defined more by her husband's roles than by her own. In the same way, the secretary or even the maid of a Hollywood film star enjoys a certain prestige among her friends not accorded to every secretary or maid.

PERSONALITY AND THE SOCIAL ENVIRONMENT

Group roles and the values which attach to them give us a rough general description of the social environment. The roles of society are like a climate to which the individual adjusts according to his general organization of behavior. The young man or woman who enters by choice or circumstance a certain role in society has the social pressures of that role imposed upon him. He must conform to the role or change the nature of his social activity. By and large, each individual's personality is organized and defined according to the interplay between his abilities and behavioral characteristics and the role structure of society.

Multiple Roles. The adjustment of the individual in the social world necessitates that he play many different social roles in the family, place of work, recreational groups, church, and so on. An individual changes his patterns of behavior—that is, displays different aspects of his personality—as he steps out of one role into another. The man in Figure 14.6 is shown in some of the roles he regularly plays. As a skilled worker he is industrious, precise, proud of maintaining his status in the shop, but perhaps bored with his job from time to time (*a*). At home, as the father of the family, he assumes the dominant role in the group (*b*). He has the last word on where the family shall go on Sunday, who is likely to win the Series, and whether Junior can go to the movies. After supper when he goes bowling, he relaxes as a member of a group of his equals, as "one of the boys" (*c*).

a c



b d

Figure 14.6. Multiple roles. The individual's personality is organized according to the multiple roles he plays in society. The man in the figure shows different aspects of his personality when he is on the job, a, *when he is at home with his family,* b, *when he is out with the boys,* c, *and in his private world of fantasy,* d.

These are but a few of the roles this individual can and does play. He changes the pattern of his behavior when he attends a union meeting, goes to the PTA, or visits his parents in another town. The last picture shows that he saves some very special roles for his private world (*d*). In fantasy or dreaming he sometimes achieves the satisfactions, excitement, or prestige that escape him in real life.

Each of the roles played by the individual leaves its mark on his personality. Different social roles have different behavior patterns associated with them. Within limits, we expect a doctor to act like a doctor, a minister like a minister, a father like a father. In many worker roles an individual must be careful not to appear "uppity"; the professional roles must avoid being vulgar.

As the individual learns to conform to the role he plays, he "internalizes" its customs and standards. In other words, his implicit habits of thinking and attitudes, as well as his overt mannerisms and skills, become organized according to the social norms of the role. A soldier not only learns soldiering, but he learns to think like a soldier. A worker acquires the standards and attitudes of a worker, while an executive becomes a part of management, overtly and implicitly. As these inner behavior patterns are learned, they tend to lose their identification with the role and become a part of the individual's personality. Because these social norms are internalized, because they are woven into the subtle, implicit behavior of the individual as well as into overt action, they are hard to change. They become part of the individual's personal pattern of adjustment.

Role Selection. There are many factors which help determine an individual's social roles—factors within himself, and others within the social situation. One of the first determinants of role is the age of the individual. The newborn infant is completely dependent on society, yet does not react to the social environment as such. The infant's first social roles are interpersonal reactions with the mother and other members of the family. He gradually assumes group roles in the family, among his playmates, and at school. Roles at all levels of complexity, from member roles to leader roles, are open to growing children and adolescents, but many of the functional roles of society are reserved for adults, who support themselves, their families, and their communities.

Sex is another factor in role selection. The strongest advocate of women's rights

cannot change the basic differences between the sexes. As the bearers of children, women inevitably are restricted in their selection of roles. Some roles are reserved for men because of physical strength required, but more often it is custom and attitude that determine male and female roles. In modern times, role differentiation on the basis of sex is becoming less important.

Individuals are limited in their role selection by their psychological make-up—their intelligence, mechanical aptitude, artistic talents, emotional stability or instability, and many other variables. There are other circumstances which determine roles but which have nothing to do with the individual's make-up. A person takes a job because it is available when he needs it. He is elected to a club because his father was a member. He joins a church because his wife belongs.

Group Identification. Especially important in determining the roles played by the individual are the social groups with which he is associated by accident of birth and the make-up of his family. The location of his home, the size of his family, his family's occupational, economic, and educational status, their religious affiliation and ethnic character are some of the social variables that determine group affiliation and thus leave their stamp on the individual (Fig. 14.7).

The individual is influenced to some extent by the nature of his home community, whether it is rural or urban, small-town or city—and the kind of residential area it is within the city. Urban and rural groups differ in occupations, in the way children are cared for and educated, in the way older people are han-

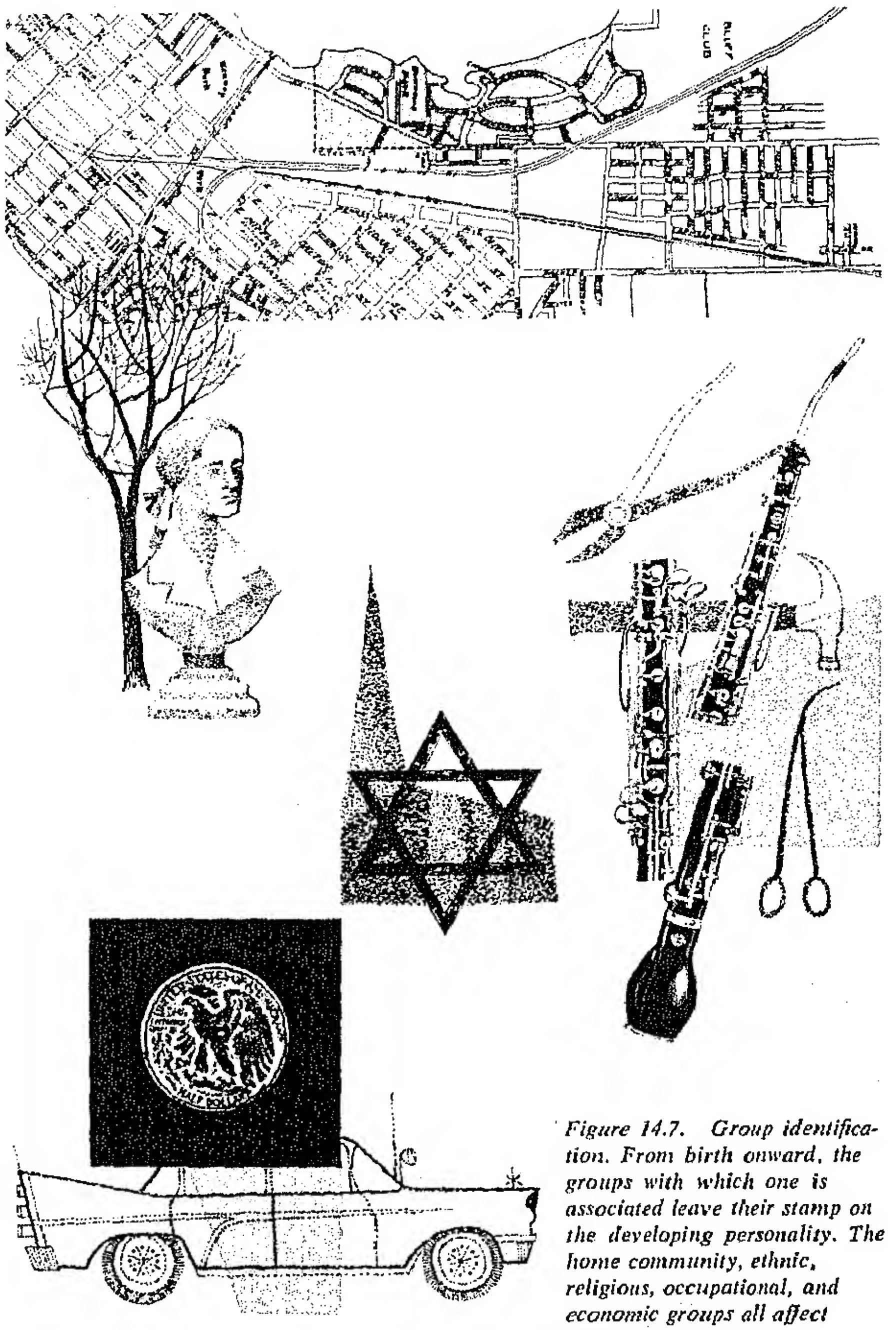


Figure 14.7. Group identification. From birth onward, the groups with which one is associated leave their stamp on the developing personality. The home community, ethnic, religious, occupational, and economic groups all affect personality organization.

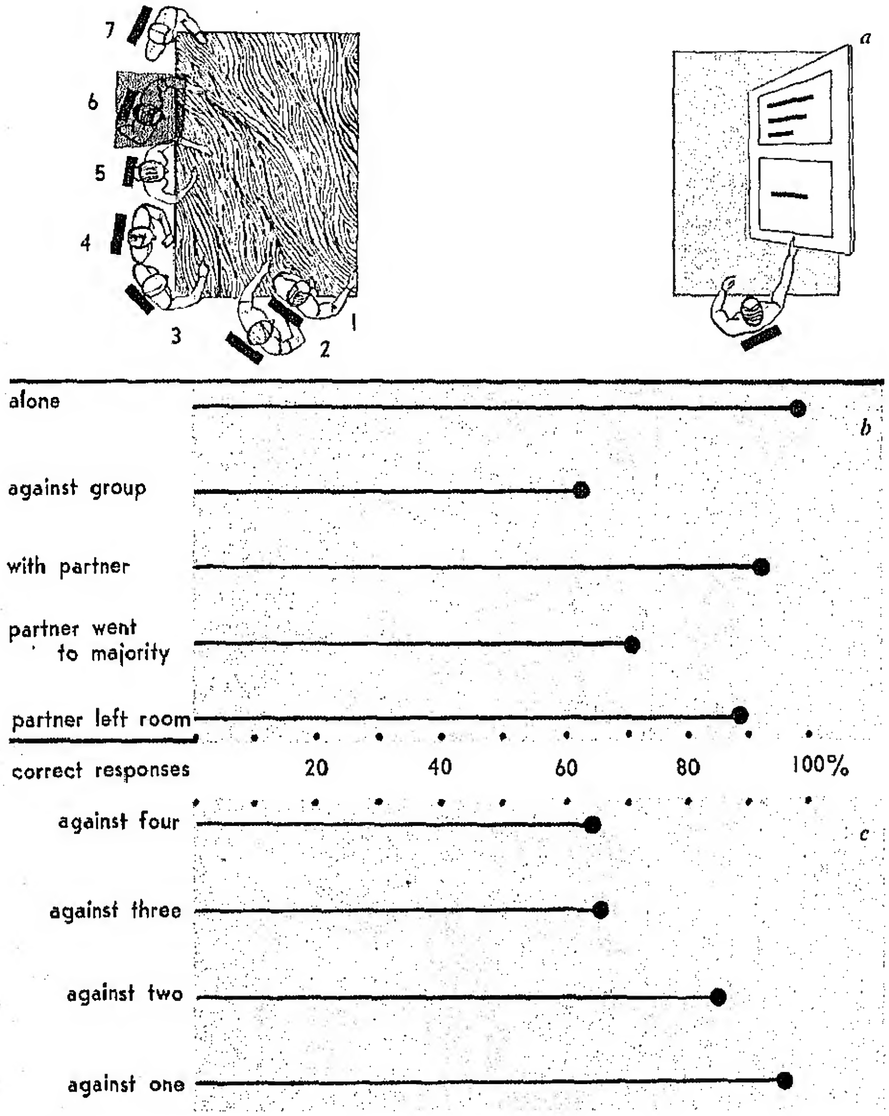


Figure 14.8. The effects of social pressure on perceptual judgments. a. *In a group of subjects asked to match lines in length, all but one had been instructed beforehand to judge incorrectly most of the time.* b. *The accuracy of the one uninstructed subject dropped sharply when he found himself differing from the whole group, went up again when another person agreed with him, dropped when his partner deserted to the majority, but held fairly well if his partner simply left the room.* c. *The size of the group influenced accuracy.* [From Asch, S. E. Opinions and social pressure. *Sci. Amer.*, 1955, 193 (5), 31–35.]

dled, in sex standards, and in many other ways. The economic and educational status of a family helps to determine not only what they will buy and wear, but also their political affiliation, and their sex habits.

The factors of residence, occupation, and education are not fixed in a person's life, and he is not likely to identify himself closely with groups defined by these variables. The rural boy moves to the city or the poor boy gets an education, a profession, and money. Religious affiliation is relatively more permanent, for many people identify themselves very strongly with their church. Even more rigid is a person's racial character.

In some parts of our country, membership in an ethnic group influences the whole life structure of the individual. This is particularly true of Negroes. One interesting study has shown the accuracy with which 253 Negro children between the ages of three and seven years correctly identified their racial roles.[2] Each child was presented with two colored dolls and two white dolls and asked to select the doll he liked best, and the one that looked like him. Sixty-six percent of the children correctly identified themselves with the colored dolls. Their accuracy varied from 52 percent at age three to 78 percent at ages six and seven. Slightly over half of the three-year-olds preferred the white doll. At four and five years, three fourths preferred white, but as their racial identification became more accurate at six and seven fewer of them preferred white.

Social Pressure. By identifying himself with particular social groups, the individual subjects himself to many influ-

ences. His patterns of behavior, motives, opinions, and beliefs are all influenced by the standards of the groups to which he belongs. Furthermore, in many closely knit groups, there is marked social pressure for individuals to conform to group standards. Some people bow to group standards more than others do, but no one is immune to social pressure in many forms. All that we know about public opinion and propaganda is based on the premise that people are sensitive to the opinions of authorities and of groups.

The urge to conform to group opinions has been studied in some significant experiments on perceptual judgments, summarized in Figure 14.8. The task for the subjects in this study was to compare the length of a standard line shown on one card with three other lines on another card and choose the one of the three variables which appeared to be the same length as the standard (*a*). One of the three variable lines always matched the standard line in length, while the other two were substantially different. On each trial the subjects called out their judgments aloud in the order in which they were seated.

The critical arrangement in this experiment was that every group of subjects included one misinformed person, who thought he was participating in an experiment on perceptual judgment. The other subjects were instructed beforehand to make prearranged incorrect judgments in 12 out of 18 trials. An experimental session started out with unanimously correct judgments on the first two trials. Then, suddenly, all but the one subject made identical incorrect judgments, leaving the uninstructed subject a minority (albeit a *correct* minority) of one. He looked surprised at this situation, and when it happened again on the next trial began to look hesitant, worried, and embarrassed. He now found himself in a strong conflict situation in which his eyes told him one thing while the rest of the group gave a unanimous contrary opinion.

Reactions to this group pressure varied. About one fourth of the subjects tested in this way maintained their independence and never went along with the erroneous judgments of the majority. Others weakened almost immediately and made their judgments according to majority opinion. Over all, the 123 subjects put to the test made wrong judgments in 37 percent of the trials, as compared with one percent error under ordinary circumstances (Fig. 14.8*b*).

This experiment was varied to discover whether the unanimity of the group opinion was the decisive factor. When one member of the group was instructed to judge correctly with the uninstructed subject, the group pressure was reduced strikingly. As shown in Figure 14.8*b*, average accuracy of one individual against a group was increased from about 63 to 90 percent when he was given the support of a truthful partner. However, if this partner suddenly "deserted" to the majority, the subject's accuracy dropped sharply. If the truthful partner simply left the room, the subject made a few more errors, but resisted group pressure much better than when his partner publicly joined majority judgment. The size of the majority group also affected the subject's judgments to some extent, as shown in Figure 14.8*c*.

The experimenter also varied the discrepancies between the standard and variable lines to see whether the subjects would resist majority judgment when the

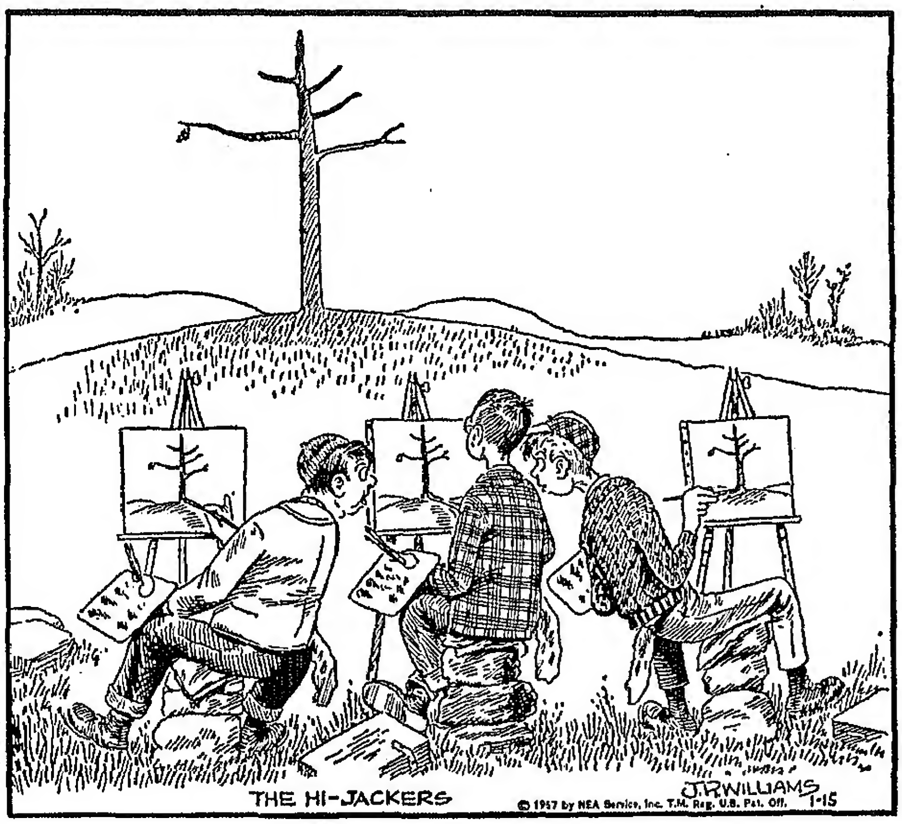


Figure 14.9. Social conformity. Our social behavior strikes a balance between individuality and conformity, although some individuals are more highly motivated to conform than others. (By permission of NEA Service, Inc.)

error was extreme. They found that even when the difference between the lines judged equal was as much as 7 inches, some few subjects still yielded and went along with the group. As we have said, some subjects made independent judgments consistently even when the group error was relatively small, but a few found it impossible to resist the pressure to conform.

Conformity. In social living an individual is subjected to many pressures to conform but is also motivated in many ways to stand out as an individual, to achieve recognition by being better than, or at least different from, his fellows. Emphasis on conformity or individuality depends to some extent on the culture, although *interpretations of these cultural values* are variable. We hear social critics who condemn our American culture as placing the ultimate good in conformity, and we hear others who say that Americans place too great a value on individual achievement, on excelling in school or on the job, not only in keeping up with the Joneses but getting ahead of them.

In most of our social behavior we strike a balance between individuality and conformity. We conform to some extent to group opinion in how we dress, what we read, the recreations we enjoy—but within the limits of individual preference. Some people are motivated more highly to conform, others to be different (see Fig. 14.9). Here, as in all forms of social behavior, *the pattern of reaction* depends on how a particular individual is influenced by the variables in his social environment. For one thing, conformity behavior depends on the way in which it has been rewarded and punished in the past. People would not conform to group standards if they were not reinforced for doing so. Furthermore, it is necessary for the individual to know something of the group standard. If the norm for the group is ambiguous, not easily perceived, there is much greater chance for behavior to be determined by individual variables.[3] Finally, we must consider again the factor of social status. Individuals are more likely to conform to the behavior of those whose status is higher.

SOCIAL MOTIVATION

In recognizing the influence of the social environment on the developing personality, we realize that all aspects of

behavior are subject to this influence. In particular, an individual's patterns of motivation are structured by his interaction with his social world. In the early development of the human individual, he is almost completely dependent on social means to satisfy his physiological needs. Thus the behavior patterns associated with the so-called primary motives are inevitably organized along social lines. Because of the division of labor in society, individuals of all ages fulfill their basic needs and secure protection through the cooperative enterprise of social groups (Fig. 14.10*a*).

In addition to the primary needs, almost all of the general motives in human life are organized in a social framework (Fig. 14.10*b*). Educational goals, scholarship, artistic achievement, scientific advance, religious and service motives, success in business or public life—these general interests which motivate the individual throughout most of his life are meaningful only in a social setting. The scholar or artist or religious recluse who isolates himself from others is not often seen in modern life. Even an enforced isolation may be motivated by negative attitudes toward society. From the sorriest day-laborer who holds a job to feed his family, to the international philanthropist, goal-directed behavior is almost entirely social behavior.

As we have just indicated, social motivation may be negative as well as positive. The world of people is a more or less inflexible system of events which can threaten and injure the individual, if need be, to maintain the established course of social behavior. In Figure 14.10*c* we see a common method of negative motivation in society—that of ostracism and ridicule. These punishments are light compared to such extreme forms as imprisonment, solitary confinement, and exile.

Social Motivation and Achievement. In many instances of goal-directed behavior, social interaction not only influences the nature of the goals sought but has direct measurable effects on the strength of the motivated activity. Not only do we adjust our goals according to social standards, but the strength of these social motives is influenced by social variables.

It is often observed that individual motivation to complete a task or solve a problem is increased when other people are participating in the same performance. Anyone who has ever taken an examina-

Figure 14.10. Social motives. a. *Individuals fulfill their basic needs and secure protection through family and group enterprise.* b. *Most general motives are organized along social lines.* c. *Social motivation is sometimes negative, to avoid punishment, ostracism, or ridicule.*

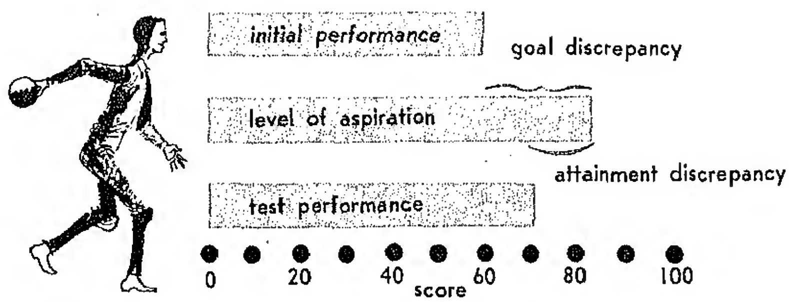


Figure 14.11. Level of aspiration experiments. When an individual aspires to better performance because of the superior performance of a group, his actual attainment tends to be somewhat better than his original performance. [Based on Lewin, K., et al. Level of aspiration. In Hunt, J. McV. (Ed.) *Personality and the behavior disorders.* New York: Ronald, 1944. Pp. 333–378.]

tion in a room filled with his fellow students, scribbling furiously, will understand this effect, which is known as *social facilitation.* It has even been observed that rats which had eaten their fill while alone started to eat again when brought together in groups.[4] Children sometimes react in the same way. The very real nature of social facilitation can be attested to by many athletes. The four-minute mile was not achieved by one runner running alone, but by a runner whose performance was skillfully facilitated by a partner on the track.

Level of aspiration. Individual behavior is guided directly and indirectly by standards of performance which are set by social groups. We see these group-determined standards operating in every phase of our lives, in the way we eat, in the clothes we wear, in how hard we work at certain tasks, and so on.

The work standards of industry represent both an example and a problem of socially determined goals. Such standards are levels of achievement expected or demanded of particular workers or groups of workers. The setting of these standards is one of the most difficult problems in the industrial relations field. Work groups impose strong pressures on individual members not to get too far above or below the average level of the group in performing assigned tasks.

The influence of social groups on individual standards of achievement can be investigated by experiments on the level of aspiration, as exemplified in Figure 14.11. An original performance is obtained from a subject in a motor, intellectual, or perceptual task and he is informed of his score in relation to the group average. Then he is asked to predict what score he expects to make on the next test. This expected goal is his level of aspiration, and shows a shift toward the announced average of the group. If the subject's performance was originally below average, his level of aspiration is raised, but if his performance was above average, his predicted goal tends to fall back. In Figure 14.11 the difference between original performance and level of aspiration is shown as "goal discrepancy." When the subject is tested the second time, his performance tends to fall somewhere in between, as shown by the "attainment discrepancy."

One study on level of aspiration with college students as subjects showed the effects of comparing their original test scores with different reference groups. The shift in goal level, as related to what the subjects were told about their scores, is shown in Figure 14.12. When they were told their scores were "below" another group, they revised their goals upward, but when they were told they tested "above" another group, they set their goals lower. The extent of change in their level of aspiration was also related to the prestige value of the reference group. The subjects aspired highest when told they were "below high school students," less high when they were "be-

low college students," and even less when told they were "below graduate students." A similar difference in goals was found when they were told they were above *another group, with the greatest decrease* occurring when the reference group was graduate students.

One's level of aspiration for a particular kind of activity is, of course, dependent upon more than the social context and group performance. *Some individuals* characteristically have very low levels of aspiration; others, very high. Abilities as determined by biological make-up and learning set the limits of one's performance, and it is unlikely that a person will maintain a high level of aspiration in the face of demonstrated low levels of performance. However, if there is sufficient discrepancy between one's performance level and his level of aspiration, serious frustration results. This factor of frustration further complicates the motivational picture. *In fact, frustration is one very* important aspect of social motivation in general. It is related to social roles and their motivational significance, and also to the more general problems of social conflict, prejudice, and attitudes.

Social Motivation and Conflict. Most of what we learned about conflict and frustration in Chapter 3 is concerned directly with social behavior. You remember that frustration occurs in the individual as a result of the blocking of motives, either by direct blocking, deprivation, or the conflict of two or more lines of motivated behavior. Conflict within the individual is usually a clash of social motives—patterns of goal-directed behavior organized in a social setting. Let us see how some of these conflicts arise.

As we have learned, an individual plays many social roles in life—interpersonal roles as well as many group roles in his family, school, work, clubs, and so *on. Usually a person can shift easily* from one role to another, abandoning one pattern of behavior for another as he moves from one group to another. On occasion, however, his roles clash, and he has difficulty in reconciling his behavior in one situation with what is expected of him, or what he wishes to do, in another situation. A clash may arise between two interpersonal roles (Fig. 14.13*a*). A young woman's relations with her father may be strained to the breaking point if he does not approve of the young man she wishes *to marry. To resolve this conflict, she* will probably be forced to revise one or both of these interpersonal roles. A common source of frustration is a conflict between an interpersonal role and a group role, as in an individual who wishes to *marry a person of another religious faith* (Fig. 14.13*b*), or a student who is torn in his loyalties to a friend and to a fraternity which does not accept his friend. This can also work in reverse. The rejected friend may find it hard to reconcile his negative attitude toward the group with positive feelings of friendship toward a member of the group. Study of the problems of interpersonal-group conflicts indicates that individuals usually act consistently in resolving such conflicts.[5] One person typically will act in terms of his *interpersonal roles* (e.g., *his loyalty to a* friend), while another will favor his group roles.

Sometimes an individual finds himself in the position of having to play two roles within the same group, which may result in intragroup conflict (Fig. 14.13*c*). For

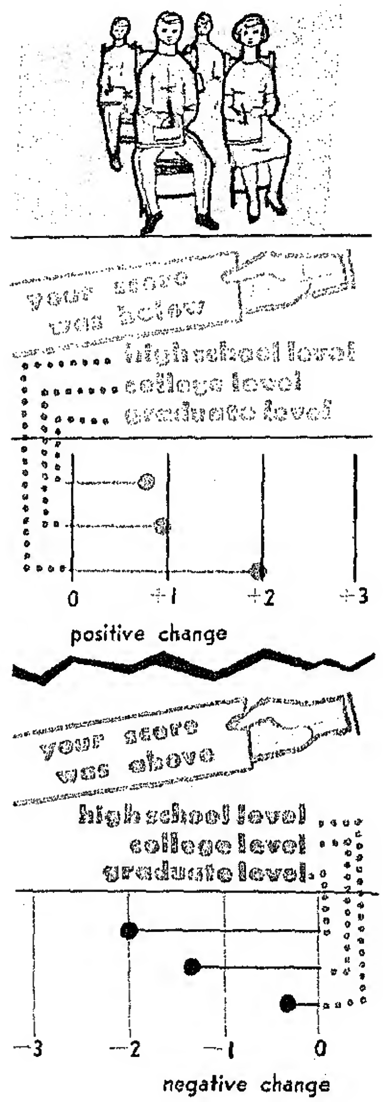


Figure 14.12. Prestige of reference groups and level of aspiration. Subjects taking tests adjusted their level of aspiration according to what they were told about the relation of their scores to a group mean, and also were affected by the prestige of the reference group. (Based on Festinger, L. Wish, expectation, and group standards as factors influencing level of aspiration. *J. abnorm. soc. Psychol.*, 1942, **37**, 184–200.)

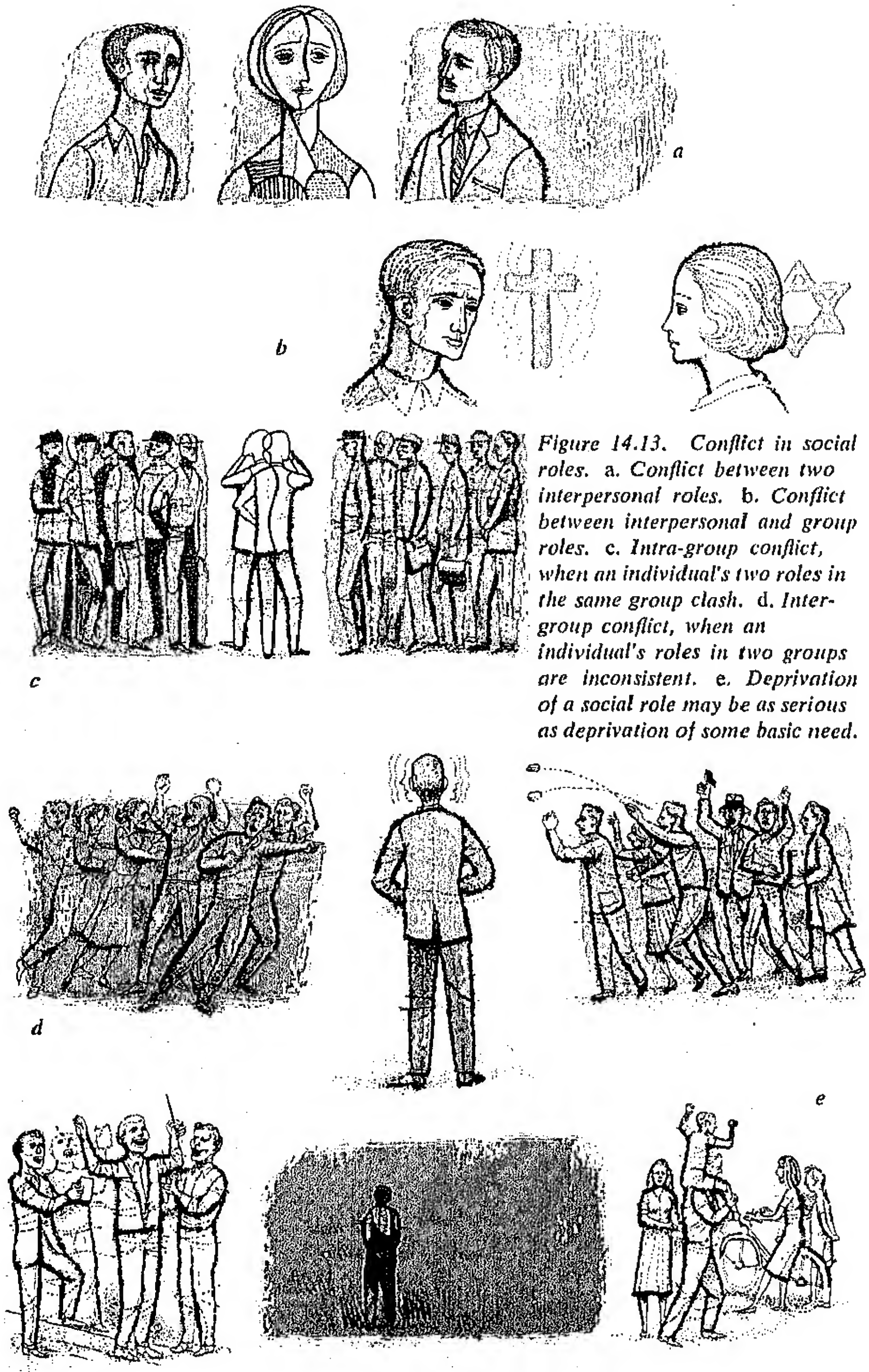


Figure 14.13. Conflict in social roles. a. *Conflict between two interpersonal roles.* b. *Conflict between interpersonal and group roles.* c. *Intra-group conflict, when an individual's two roles in the same group clash.* d. *Inter-group conflict, when an individual's roles in two groups are inconsistent.* e. *Deprivation of a social role may be as serious as deprivation of some basic need.*

example the father of a family may enjoy maintaining his status as the generous, free-spending purveyor of gifts and entertainment, but at the same time be forced to tighten the pursestrings in order to balance the budget. The resulting frustration may force him to engage in outside money-making activities or to seek a better-paying job. Or, a successful middle-aged businessman may find his role as a dutiful son to aging parents conflicting with his role as their protector who must support them and make decisions for them. A member of an organized group who becomes its leader sometimes finds that the two roles conflict. A union leader is in sympathy with the immediate desires and the emotional prejudices of his fellow members, but as their leader knows that some of the immediate goals must be sacrificed to long-term goals and general good will.

Since most people play roles in many groups, it is not surprising that sometimes these roles conflict and lead to serious frustration. Many people find it possible to play diverse roles without worrying about the inconsistencies among them. Each role is categorized and kept entirely separate from other roles in the life of the individual. This diversity, in fact, is often a useful aspect of social roles. A worker who is forced to be polite and hold his tongue while on the job finds relief in being dominant and aggressive in his family, and relaxed and easy-going with his friends. Conflict arises when the basic attitudes and beliefs attending one role are challenged by affiliation with another group (Fig. 14.13*d*). More than one student who is a member of a conservative religious group has found this role conflicting with that of a scientific

skeptic. Bitter conflicts often arise when differences of opinion in a group lead to the formation of sub-groups within it. When a church or club becomes involved in a squabble and the members choose sides, each member is torn between his loyalties to the group as a whole and his loyalties to the sub-group with which he has affiliated himself.

If an individual is deprived of a social role suddenly or unexpectedly, the deprivation may be as serious as the lack of some basic need, such as food. The individual in Figure 14.13e finds himself in a social vacuum. The role around which a part of his life was organized no longer exists. The child who is separated from his family may respond to the vacuum by becoming homesick. Losing a job may have serious emotional and motivational consequences as well as economic results. Studies of the unemployed during the great depression of the 1930's showed that their inability to find a job or work role had marked effects on personality.[6] Emotional instability, low self-confidence, a broken spirit, a lack of balanced values, cynicism, and suspicion of others were marks of the unemployed. If the vacuum created by loss of a role cannot be filled by the development of a new one, the deprived individual shows persisting loss of motivation and depression.

Genesis of Social Conflict. The kind of conflict that may occur between groups finds its origins in the blocking of motivated behavior and resulting frustration. Some social conflicts—union-management disputes, for example—occur between groups of individuals who are associated through the similar roles they play. Each group has common objectives which to some extent are thwarted by the other group. Such conflicts are highly structured according to the social motives of each group as a whole.

Many individuals become drawn into a class conflict of this sort more because of their group loyalties than because of individual frustrations. When a serious union-management dispute leads to strikes and industrial warfare, the entire community may become involved. In such cases, the lives of individuals are radically changed. Brother may come to hate brother. Open fights may occur. Some families move away to escape an unbearable situation. No one knows the effect of such an atmosphere on children or on the health of everyone concerned.

Racial conflict characteristically develops according to a different pattern. As we learned in Chapter 3, frustration common to members of a group will generate aggressive behavior toward members of out-groups. Such behavior directed toward another group when there is no logical basis for the selection of that particular out-group would be an example of displaced group aggression, or *scapegoating*. When times are hard—when individuals are deprived of their needs, or blocked in achieving their goals—they are likely to displace their aggression against a minority group which is not in a position to retaliate. The German Nazis chose the Jews as a national scapegoat.

Factors in Prejudice. One of the best examples of how social conflict is reflected in both individual behavior and group action is in the case of prejudice, a social problem which has received considerable attention in recent years. In the United States, most white non-Jews have

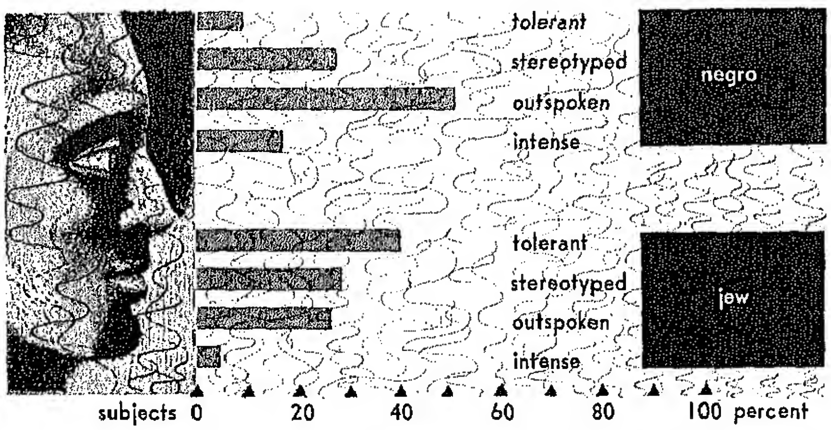


Figure 14.14. Attitudes about Negroes and Jews among 150 army veterans in Chicago. Those veterans who had improved their socio-economic status after discharge from the army were inclined to be more tolerant than those who had moved lower in status. [From Bettelheim, B., and Janowitz, M. Prejudice. *Sci. Amer.*, 1950, 183 (4), 11–13.]

stereotyped opinions and attitudes about Negroes or Jews, or both. Some individuals are openly hostile toward members of these minority groups, particularly when a source of frustration exists. For example, in Chapter 3 we mentioned a study which showed that the number of Negro lynchings in the South was correlated with the price of cotton. More lynchings occurred when the price of cotton dropped in hard times.

A study of prejudice against Negroes and Jews among 150 army veterans living in Chicago after World War II revealed a similar relationship between hostility and economic insecurity. The attitudes of the men toward both Negroes and Jews were evaluated by information obtained in interviews and used to classify them into four groups. Those who spontaneously expressed hostile attitudes without being asked were rated as Intensely Prejudiced. Those whose hostility was expressed only in answer to direct questions were rated Outspoken. Those who expressed various stereotyped notions, not necessarily unfavorable, were rated Stereotyped, while those who revealed no elaborately stereotyped beliefs were rated Tolerant. The distribution of the four kinds of attitudes against both Negroes and Jews is shown in Figure 14.14.

These results were analyzed in relation to a number of individual and social variables in an attempt to discover factors contributing to the degree of hostility. There were no significant correlations between intolerance and age, education, religion, political affiliation, income, social status, or preferences in newspapers, magazines, or radio programs. Nor was intolerance related to *actual* hardships or privations suffered while in the Army. However, those men who *felt* that they had had bad breaks in the Army were the most hostile toward Negroes and Jews.

It was found that there was a close relation between racial attitudes and *social mobility*. Those veterans who had moved up in socio-economic status after discharge from the Army were inclined to be tolerant, while those who had moved down were most inclined to be hostile. Further, those men who accepted *social control*, as indicated by their acceptance of social institutions, were more tolerant than those who did not. For example, men who had stable religious convictions, who approved of the political party system, and who accepted the Federal government were more tolerant than those who rejected these social institutions.

While it is not possible to point out simple causal relationships in the expression of prejudice any more than in other complex forms of behavior, this study and others emphasize some important relationships. Conflicts between ethnic groups are associated in general with feelings of insecurity and frustration, a lowering social status, and at least partial rejection of established social institutions. One of

the important outcomes of these factors is the expression of racial and religious intolerance or prejudice. Children usually get their prejudices ready-made, directly from parents and others with whom they are closely associated. Whether their hostility and intolerance of various minority groups is sustained depends partly on the extent to which the significant factors contributing to conflict or frustration are found in their adult life.

GROUP DYNAMICS

So far, our discussion of social behavior has been concerned mainly with the effects on individual behavior of a number of social variables. We are also interested in the effectiveness of groups as such, in exchanging ideas, solving problems, and carrying on cooperative enterprises. Studies of the organization of groups and the interrelationships which exist among their members are of interest not only to psychologists and social scientists, but to leaders and human relations workers in all walks of life.

Level of Organization. In order to act effectively, a group must have some degree of organization. The degree of organization depends upon the proportion of specialized positions to the total membership of the group.[7] In a highly organized group, each member has a specific role and interacts in a coordinated way with the other members.

An organized group which is accustomed to working together carries over some of its effectiveness into situations not related to its ordinary functions. In one study, the behavior of ten groups consisting of six members each was analyzed in a frustrating problem-solving situation.[5] Five of the groups were unorganized, consisting of undergraduate students who did not know each other. The other five were organized athletic teams. Each group was asked to solve three problems which appeared simple enough but were actually extremely difficult if not insolvable. In this situation the organized groups displayed a greater motivation to complete the problems, a higher degree of solidarity, and greater feelings of frustration at failure.

Highly organized groups can actually improve their operational efficiency under stress, as shown by experiments carried out with air-defense crews operating a direction center. A crew of 30 to 40 men manned a direction center for a total of about 200 hours, during which time they had the job of defending a hypothetical

Figure 14.15. A highly organized work-group. Air-defense crews working under stress learned to reorganize their activities and improve their efficiency as the task load was increased. [From Chapman, R. L., and Kennedy, J. L. The background and implications of the systems research laboratory studies. In Finch, G., and Cameron, F. (Eds.) *Symposium on Air Force human engineering, personnel and training research.* ARDC Technical Report 56-8, 1956.]

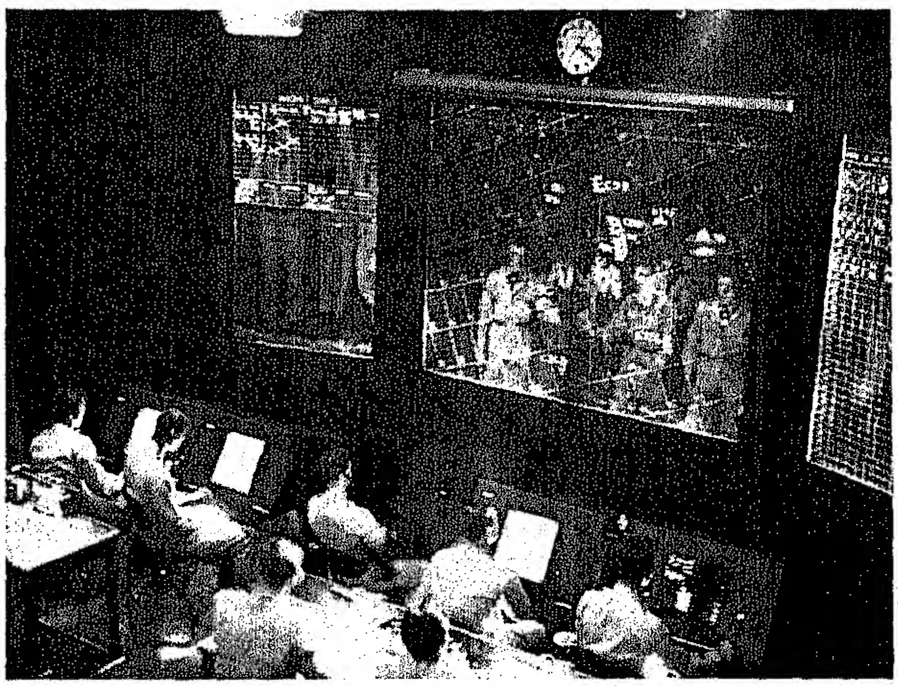
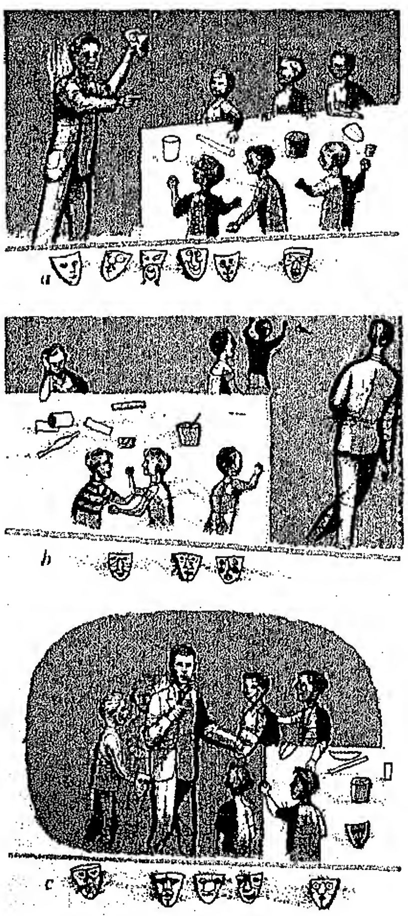


Figure 14.16. Effects of social climate on group behavior.
a. *Authoritarian leaders got the most work done, but were not liked.*
b. *Laissez-faire groups accomplished little and did not like their club.*
c. *Democratically led groups were the most satisfactory to the members.*
[Based on Lewin, K., Lippitt, R., and White, R. K. Patterns of aggressive behavior in experimentally created social climates. *J. soc. Psychol.*, 1939, **10**, 271–299; Lippitt, R., and White, R. K. An experimental study of leadership and group life. In Swanson, G. E., et al. (Eds.) *Readings in social psychology.* (Rev. Ed.) New York: Holt, 1952. Pp. 340–355.]



area of 100,000 square miles against air attack. Simulated information on air traffic was fed to these crews. They had to analyze the information and use the weapons at their command for air defense with split-second timing (Fig. 14.15).

The most outstanding result was the effectiveness with which this highly organized crew could mobilize its resources and reorganize its patterns of behavior as the task load was increased. The simulated air traffic was steadily increased during the experiment until the task load was three times as heavy at the end as at the beginning. Each time the crew seemed to have reached its performance limit, a way of simplifying the procedures was found.

It is interesting to compare this group learning under stress with individual performance. Just as one person learns to reorganize his behavior to solve a challenging problem, this social group modified its procedures and streamlined its organization to keep pace with an ever more difficult task.

Type of Organization. The "climate" of a social group as well as its level of organization influences the motivation of its members and their effectiveness in group action. An early study in group dynamics dealt with the method of organizing a group in terms of the type of leadership provided. Three basic styles of organization—*authoritarian, democratic,* and *laissez-faire*—were tried out in experiments with clubs made up of ten-year-old boys. Each club had five members and met after school on a voluntary basis for several months. The young men who served as leaders were trained in the three styles of leadership and shifted from one style to another every six weeks as they changed clubs in order to rule out the effects of their personalities. Authoritarian leaders named the club and dictated all activities and work assignments. Democratic leaders led group discussions to make all decisions and settle all problems. Laissez-faire leaders were available for help or advice when asked, but never interfered in activities or volunteered suggestions. The democratic group always decided on its projects after group discussion. When they had decided on some activity, such as mask making, the same activity was imposed on the authoritarian club by the leader, while the laissez-faire leader provided materials for mask making, so that his group would sooner or later use them to some extent. Figure 14.16 illustrates the different clubs.

In terms of amount of work completed, the authoritarian group was most efficient. However, when the leader left the room, work in this group stopped. The democratic group finished less work, but they showed more cooperation and continued working when their leader was absent. The laissez-faire group did practically no work, and spent most of their time in horseplay.

From the point of view of the motivation and satisfaction of club members, the democratic group was clearly superior to the others. They liked their leader, developed a strong feeling of group solidarity, and displayed responsible attitudes toward their work. An outsider who criticized their work could not break up their group feeling. The members of the authoritarian group, although finishing the most work, were dissatisfied with their leader, and formed cliques within the group. An outsider could cause dissension in the group. Some members became very submissive to the leader, while others

showed aggressive behavior. When an authoritarian-led club was shifted to a democratic leader, the members showed a lot of aggressive behavior before they could settle down to democratic ways.

The laissez-faire club was poorest from all points of view. They accomplished little, did not like their leader, and were dissatisfied with their club. Their activity was mostly unorganized play, and hostility often developed.

These results, which have been confirmed by other investigations, have broad implications not only for children's activities but for educational practices and organized group action at many levels. Although there may be times when authoritarian procedures are necessary to get work done in a hurry, there is apparently no excuse for the leader of a group to adopt a completely hands-off attitude. With no guidance at all, the groups of boys were neither efficient nor satisfied. We hear a lot about "permissive" methods in handling children. To be effective, a permissive leader should also participate to some extent in group activities, providing help and guidance, in order to create a stimulating social climate.

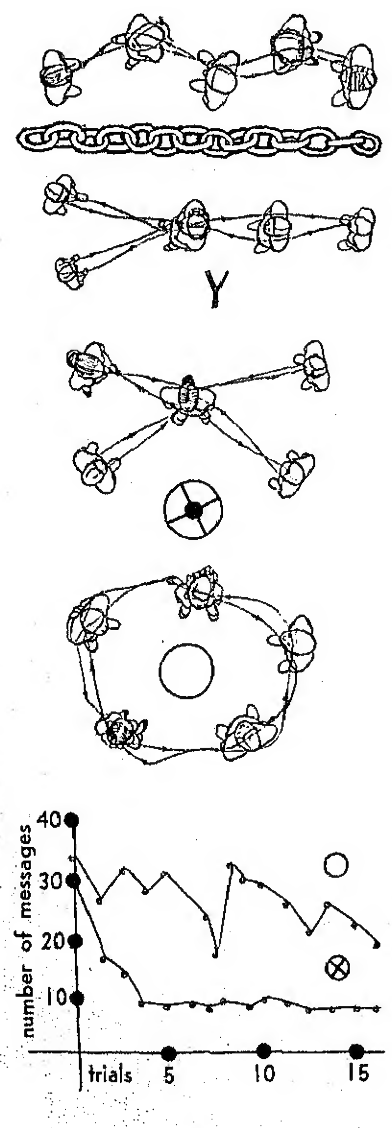
Group Decision and Efficiency. One of the chief functions of social groups is to make decisions regarding courses of action to be taken by their memberships. How such decisions are made and their effects on the motivation, morale, and efficiency of individual members are important features of the study of group dynamics. An investigation of a recurrent problem in industry can illustrate how the organization of a group influences the behavior and effectiveness of its individual members.

The problem just referred to concerns the resistance typically displayed by workers when their jobs are changed or methods of work are altered. When individuals are shifted from one job to another, production often suffers and some quit their jobs. An experiment in a clothing factory was carried out in an attempt to find a way of preventing this loss in personnel, time, and money.[9] Four groups of girls on piece-work rates were affected by a change required in the methods of carrying out a job. The first group was told that the change would take place, that they would get a bonus during the relearning period, and that the new production standard would be as easy as the old. This procedure can be compared with the methods of the authoritarian leader described previously. Two groups were handled democratically. The reason for the proposed change was explained and the girls were allowed to participate in planning the job layout. The fourth group did not participate as a whole, but two of their number represented them in discussion and planning sessions and reported back to the others.

The results showed a clear superiority for the democratic method of group participation. Whereas the first group dropped markedly in production and never recovered its previous level, the democratic groups dropped very little and almost immediately achieved higher production rates than before. The fourth group showed decreased production for a time, but after several weeks approached the level of the democratic groups. During the first 40 days after the change, 17 percent of the first group quit, while none of the other three groups did so.

As further evidence of the value of group participation in decision making, the first group was subjected to another

Figure 14.17. Communication nets. Groups of students solved problems using prearranged patterns of communication. The wheel was most efficient in terms of number of messages needed, while the circle was least efficient. In the wheel, the Y, and the chain, the person who received the most information was recognized as leader. (From Leavitt, H. J. Some effects of certain communication patterns on group performance. *J. abnorm. soc. Psychol.*, 1951, **46**, 38–50.)



job change, but this time with full participation in discussion and planning. Following this change they showed the same rapid increase in production as the other "full-participation" groups. We can conclude that the kind and amount of member participation in group planning has a direct bearing on individual motivation and group efficiency.

Nature of Group Communication. The level of organization in a social group, the influence of leaders, group efficiency, and similar aspects of group behavior are all related to the basic process of communication—the process which makes social behavior possible in the first place. It is possible to study specific patterns or forms of communication within a group by controlling the factor of who can communicate with whom. The group then is given a problem, and the nature and number of "messages" sent and received, as well as other reactions of the individuals, are measured during the process of solution.

In one set of experiments of this kind, groups of five students were given tasks of solving simple problems. Solutions to the problems depended upon the individuals' communicating with each other according to predetermined rules. Each subject sat in a cubicle and communicated with one or more of the other subjects by passing written messages through slots. Four basic plans of communication, or "nets," were set up, as shown in Figure 14.17: the "chain," the "Y," the "wheel," and the "circle." The arrows pointing from person to person indicate the channels through which communication was allowed. Thus in the circle each person could communicate with the one on each side of him, while in the wheel all messages had to pass to and from the center.

In successive trials, the Y and wheel patterns evolved a system in which the central person made decisions. Organizational development took place more slowly in the chain, and none at all occurred in the circle. The graph in Figure 14.17 shows the difference between the least efficient net, the circle, and the most efficient, the wheel, if efficiency is measured in terms of number of messages. However, the time scores showed very few consistent differences among the different patterns, except that the wheel, *at its fastest,* was considerably faster than the circle at its fastest. More recent studies of communication patterns indicate that there is no "best" pattern.[10] For example, nets which are fast at solving complex problems transmit many messages. These studies of the relative efficiency of communication nets have implications for developing the best types of operating groups in business offices and other complex group organizations.

Group Determination of Leader Roles. In the study described in Figure 14.17 some significant observations were made on emergence of leaders in the different patterns. After the experimental trials had been completed, the members of the groups were asked if their group had a leader, and who it was. The recognition of the leader role depended almost entirely on the person's position in the net. In the wheel, the person at the center was unanimously recognized as leader. The choice was almost as definite for the person at the fork of the Y and the one at the center of the chain. No generally recognized leader emerged in the circle. In other

words, in this experiment the function of leadership was bestowed on the person who handled the most information.

In social groups which function in a less rigid and prescribed manner than these communication nets, leadership depends less on group structure and more on the qualities of the individual. That is not to say that some people are necessarily "born leaders." The ability of an individual to lead a group depends on a complex of developmental and learned factors, interacting with the particular group situation which confronts him.

An experimental study of the interaction of small groups of people has shown how social roles, including leader roles, differentiate.[11] Small groups of persons who did not know each other before the experiment were asked to discuss a complex human relations problem for forty minutes and then to present a report of their conclusions. Each member of the group was given a factual summary of the problem before the conference, but no further instructions. Since no leader was designated, their group activity involved an organizational process defined only by interactions of the members.

In these free-group situations, usually not one but two leaders emerged, of different sorts. There was the "idea man," the one who had the best ideas. Usually he was the one who did the most talking and was most successful in getting his ideas adopted by the group. Occasionally he was also the "best-liked," but more often another person assumed this position. The best-liked man usually was one who was responsive to the idea man, relieved group tension by smiling and laughing, and also served as a rallying point for negative attitudes toward the idea man. A reciprocal relationship often developed between these two "specialists." The idea man addressed himself to the responsive, best-liked man, who in turn did a lot of talking and agreeing but did not refrain from disagreeing on occasion. His reactions, now positive, now negative, seemed to be emotionally gratifying to the entire group.

In groups which developed no clear-cut leader, a third type of specialist was likely to appear: the one who talked the most but neither was the best liked nor had the best ideas. Leadership in these groups shifted from one to another member in the different sessions.

Group Behavior and the Individual. In this chapter we have touched briefly on the structure of the social environment, its role in personality development and motivation, and the interplay of individual and group variables in the determination of social behavior. However, in studying the dynamics of group behavior, we should not lose sight of the tremendous range of variation in individuals.

In the concluding chapters of this book we are going to learn more about individual differences in intelligence, motor abilities, special aptitudes, and personality, as well as the extreme variations in behavior known as the behavior disorders. These differences among people have a dual origin: the biological structure of the individual and the social structure of his life. Intelligence is not a tangible part of the body, like a hand or a foot or curly hair. It is determined in part by the maturational development of the individual, but is a function also of his social development. Intelligence, like personality, is defined by social standards.

The machinery of society which delineates human standards of conduct, honesty, loyalty, love, achievement, and the like provides also the means of identification of persons who cannot or do not conform. The delinquent, the criminal, the neurotic or psychotic individual, as we shall learn later, is not so much a victim of biological dysfunction as of maladjustment in the social environment. Even the extremes of human characteristics must be understood in the light of the structured roles and culture of the society in which they evolve.

SUMMARY

Social behavior occurs on four levels: as aggregations, interpersonal behavior, free group activity, and culturally defined action. The nature of reacting individuals helps define the social and cultural environment, and the adjustment and personality of the individual is in turn influenced by society.

Social roles are patterns of social behavior requiring special abilities on the part of the individual. In addition to interpersonal roles, everyone has many group roles in society. The significance of a social role depends on its complexity, its function in society, and the cultural values that attach to it. All of these variables in the social roles carried out by an individual help determine his prestige and his social adjustment.

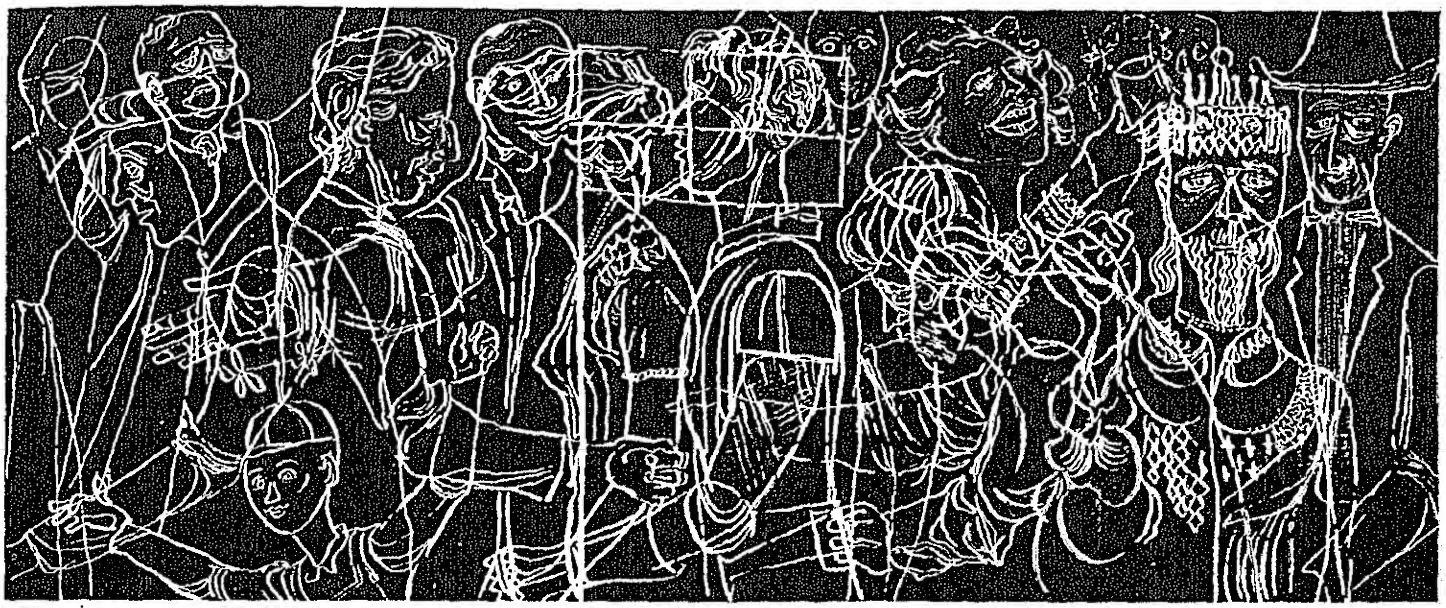
An individual's personality is organized in the interaction of his abilities and behavioral characteristics with the role structure of society. Each role played by an individual leaves its mark both on his immediate patterns of adjustment and on his persisting characteristics.

The determining factors in role selection are both individual—age, sex, abilities, and so forth—and circumstantial. The social, economic, ethnic, and other groups with which an individual is associated help determine his social roles. He is subjected to social pressure to conform to the standards of the groups. Conformity is determined by individual variables, the rigidity of group standards, prestige variables, and others.

Almost all human motives are organized in a social framework—primary motives, general goals, and the motivation to avoid rejection by society. Social interaction has measurable effects on goal-directed activity, as measured in level-of-aspiration experiments.

Conflict of motives which results in frustration is more often than not a clash of social motives, or social roles. Role deprivation can also induce frustration. Conflict between social groups comes about because of the clashing of the objectives of two groups, or because frustrated individuals in one group displace their aggression toward members of an out-group in scapegoating. Ethnic conflicts and prejudice are associated with feelings of insecurity and frustration, a lowering social status, and at least partial rejection of the established institutions of society.

The effectiveness of groups as such in carrying on cooperative enterprises is influenced by the level of organization within the group, the social "climate" of the group, the degree of participation in group decisions, and the available channels of communication. Group leadership is defined in part by the organization of the group, but more by individual characteristics.

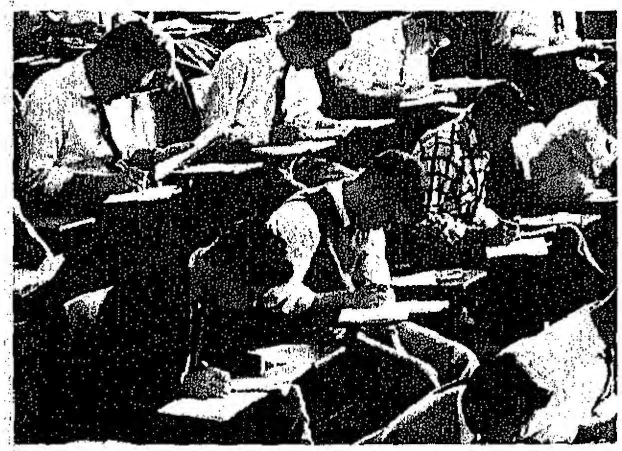


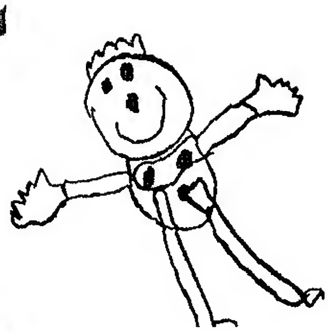
CHAPTER 15. INDIVIDUAL DIFFERENCES

Our study of social behavior has acquainted us with some of the aspects of the activities of people in groups, and has also introduced us to the real significance to society of the differences among individuals. Organized group behavior is based on differences among individuals; without these functional differences no organization could exist. The division of labor in social groups demands that society not only utilize, but select, enhance, and specialize through training the fundamental differences that exist among people. A large area of psychological research is devoted to methods of scientific measurement of differences in intelligence, skills, perceptual abilities, mechanical aptitudes, emotional characteristics, and other special aptitudes.

MEASURING INDIVIDUAL DIFFERENCES

Some of the differences that exist among individuals can be measured along simple physical scales—height, weight, reaction time. These simpler characteristics influence a person's behavior and adjustment in society and are a part of the general field of *differential psychology* —that is, the psychology of differences. However, it is the more complex behavioral differences among people with which we are concerned here. Differences in





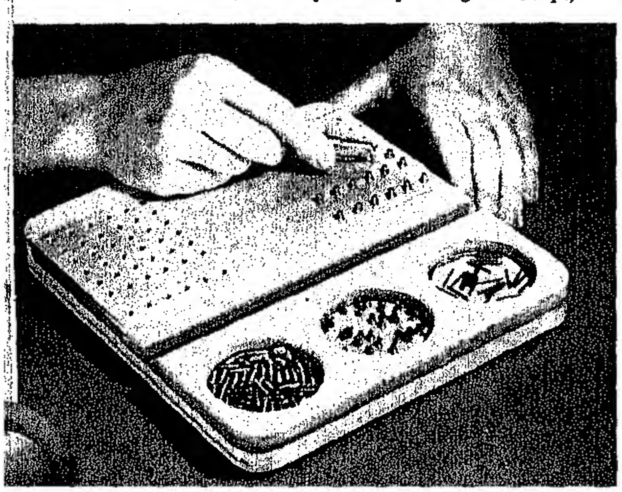


Figure 15.1. Samples of behavior used as test items. a. *A task from the Wechsler Intelligence Scale for Children.* (Courtesy the Psychological Corp.) b. *Students taking a group test.* (Courtesy the Educ. Testing Service, Princeton, N. J.) c. *A child was asked to "draw a picture of a man."* (See Goodenough, F. L. *The measurement of intelligence by drawings.* Yonkers-on-Hudson, New York: World Book Co., 1926.) d. *Manual skill as tested by the Crawford Small Parts test.* (Courtesy the Psychological Corp.)

intelligence and other special abilities have been recognized by man since primitive times, but only recently have they yielded to objective measurement. The tools for their measurement are the many psychological tests in use today.

Testing Abilities. The first problem in measuring an ability is to choose some aspects of behavior that can be measured. A psychological test measures selected samples of a person's behavior which are believed to indicate his level of excellence in a particular ability. The different items in an intelligence test are selected because they are believed to vary with an individual's intellectual ability. The same is true of tests of mechanical ability, musical ability, and so forth.

The photographs in Figure 15.1 show some of the different kinds of behavior used as test items. The child in Figure 15.1*a* is arranging the parts of a horse. Figure 15.1*b* illustrates a testing situation familiar to students everywhere. Paper-and-pencil tests are used widely to measure selected items of verbal knowledge and skill, particularly in group testing of intelligence or scholastic achievement. The behavioral skill represented in Figure 15.1*c* is a very ordinary task which is used in a test designed for young children. The child is simply asked to "draw a picture of a man," and his performance is judged according to the number of parts of the body he includes in his drawing. Figure 15.1*d* shows a person performing a skilled task which requires him to insert small metal parts into the holes of an assembly plate.

The student may wonder how these samples of behavior are selected. Who decides what to put in a psychological

test? In constructing a test, a psychologist calls upon his own knowledge of behavior and his own ingenuity in selecting or devising test items. These original samples are then subjected to very rigorous procedures, which we shall examine later, to determine whether or not they are suitable. Since human abilities are very complex, we know that one sample of behavior will not provide a good measure; tests are therefore made up of many samples or many items. Some tests include a number of subtests which sample different types of knowledge or skill. This type of test is known as a *battery*.

Achievement and Aptitude Tests. The construction of a test depends first on how it is to be used. Not only do we need to distinguish among different types of abilities, but we also must distinguish between what a person can do now in a particular type of performance and what he is capable of doing. An *achievement test* tells us a person's level of achievement in a particular skill or field of knowledge. An *aptitude test* tells us something of a person's capabilities of achievement. The one is concerned more with present abilities, the other with potential abilities. When we test the intelligence of children, we are trying to measure indirectly their potential intellectual abilities. We can use these test results to predict their future performance in school or their capabilities in intellectual pursuits. When we test scholastic achievement, on the other hand, we are trying to assess the level already attained—the student's present ability in mathematics or English, for example.

Achievement and aptitude tests serve very different purposes as they are used in the schools, in industries, in the military services, and in other areas. If machinists, or drivers, or typists are to be hired in the expectation that they should immediately perform their jobs acceptably well, they can be selected on the basis of achievement tests. School children can be placed at a certain grade level, or college graduates admitted to professional schools, on the basis of present achievement. On the other hand, industrial or military training programs are concerned with selecting persons who have aptitudes for different types of tasks. Selecting a machinist and selecting a trainee who shows mechanical aptitude are two very different problems for the test psychologist.

In spite of the different uses to which they are put, achievement and aptitude tests are alike in one respect. Both of them measure actual performance, observable patterns of behavior. When we speak of an "aptitude," or a "capability," or a "potentiality," we are inferring something about a person's behavioral organization which cannot be seen or defined except in terms of present achievement. Our inferences are based, however, not on the performance of a single individual, but on our accumulated knowledge of the behavior of many people in test performances as well as in their adjustment to real-life situations.

Since human abilities develop and change with age, the selection of test items depends in part on the age groups to be tested. Thus the "Draw-a-Man" test in Figure 15.1*c* is a suitable item for young children but not for adults. As we shall see, the age variable is particularly important in the construction and interpretation of intelligence tests.

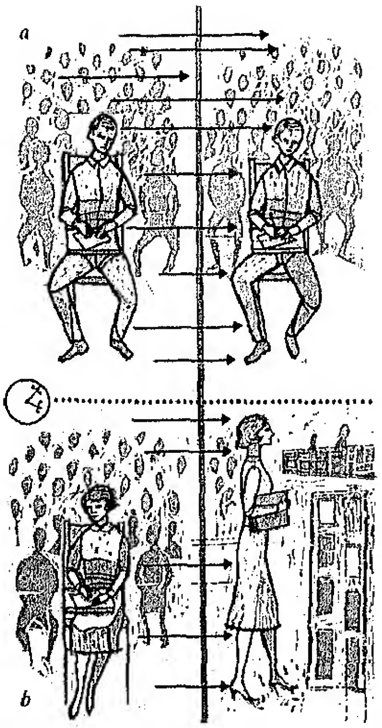


Figure 15.2. Measuring reliability and validity of tests. a. *A measure of the reliability of a test is the correlation obtained between the test scores of the same group of persons taking the test on two different occasions.* b. *The validity of a test must be determined by correlating test scores against some outside criterion of success, such as performance in school or on the job.*

Reliability and Validity. Of the hundreds of psychological tests in use today, some are better than others; that is, some of them give more dependable measurements than others. The standardized intelligence tests in use in our schools, either group tests or individual tests, are known to be dependable when given by a competent examiner. In contrast, some of the "tests" of marital compatibility, will power, or honesty which appear from time to time in newspapers and magazines are not dependable psychological tests but just series of questions on interesting topics. What are the criteria by means of which we can judge the dependability of a test?

A quantitative measurement of any event is dependable and useful insofar as it is *reliable* and *valid*. By reliable we mean repeatable or consistent. A ruler is a reliable measuring scale for distance and a thermometer for temperature because each gives consistent measurements from one time to another. The validity of a measuring device, on the other hand, depends on whether it measures what it intends to measure. A ruler and a thermometer, in addition to being reliable, also are valid in that they measure distance and temperature, not weight or time.

In general, psychological tests are neither as reliable nor as valid as most physical measures, and the development of tests is largely a matter of determining their reliability and validity and improving them. The reliability of a test can be judged by giving it to the same group of people on two different occasions, as shown in Figure 15.2*a*. If the relative order of scores for the different individuals remains much the same on both occasions, the reliability of the test is judged to be high.

One factor contributing to reliability is the *objectivity* of the test. A test item is objective if it can be scored the same by different individuals or by the same individual at different times. Essay-type questions on examinations are not usually as reliable as true-false or multiple-choice because their scoring depends on the subjective judgment of the examiner. Two persons might score essay answers quite differently; in fact, it is difficult for one person to score them consistently from one time to the next. It is to insure reliability that standardized tests are usually very objective in character. If there is any room for subjective judgment in scoring a test, the examiners must be very carefully trained to be consistent—that is, reliable—in their interpretations.

The validity of a test is more difficult to assess than its reliability. How do we know, for example, that an intelligence test really measures intelligence, or that a test of musical talent measures just that? To judge validity, we need to resort to some "outside" criterion of performance which we believe provides a different measure of the ability we are trying to test. The validity of test scores can be judged by comparing them with performance in a real-life situation. Thus scholastic achievement is one criterion of the validity of intelligence test scores. As suggested in Figure 15.2*b*, an outside criterion of the validity of a vocational aptitude test might be success on the job. A high degree of correspondence between test scores and performance constitutes a measure of high validity. Usually we are not satisfied with one criterion of validity but try to use several. Although a test can

be reliable without being valid, it cannot be valid unless it is reliable.

Standardization of Tests. The validity of a psychological test is not an absolute measure, but has meaning only in relation to the group of individuals on whom the test is standardized. The *standardization* of a test refers to the process of establishing *norms* for its use and scoring. This is done by giving it to a sample population representative of the individuals for whom the test is intended.

The construction of scales to measure human abilities is based on the premise that these abilities are distributed in a population according to a normal distribution curve (see Chap. 2). One of the criteria of a dependable test is that the scores obtained in giving it to a representative group should approximate a normal curve. Thus after a test has been tentatively designed by selecting appropriate items, the first procedure in its standardization is to give it to a large group of people. The make-up of that standardization group determines the kind of population for whom the test can be used. For example, if an intelligence test is standardized on a group of native-born, English-speaking American children it would not be a valid scale for measuring the intelligence of children in any other country, or even children in a predominantly foreign section of an American city. There are some tests designed to be used for people of different languages and cultures, but for this type of test the standardization data should be obtained with a mixed group.

After a test is designed and the standardization group is selected, specific measures of reliability and validity are obtained. A common method of determining

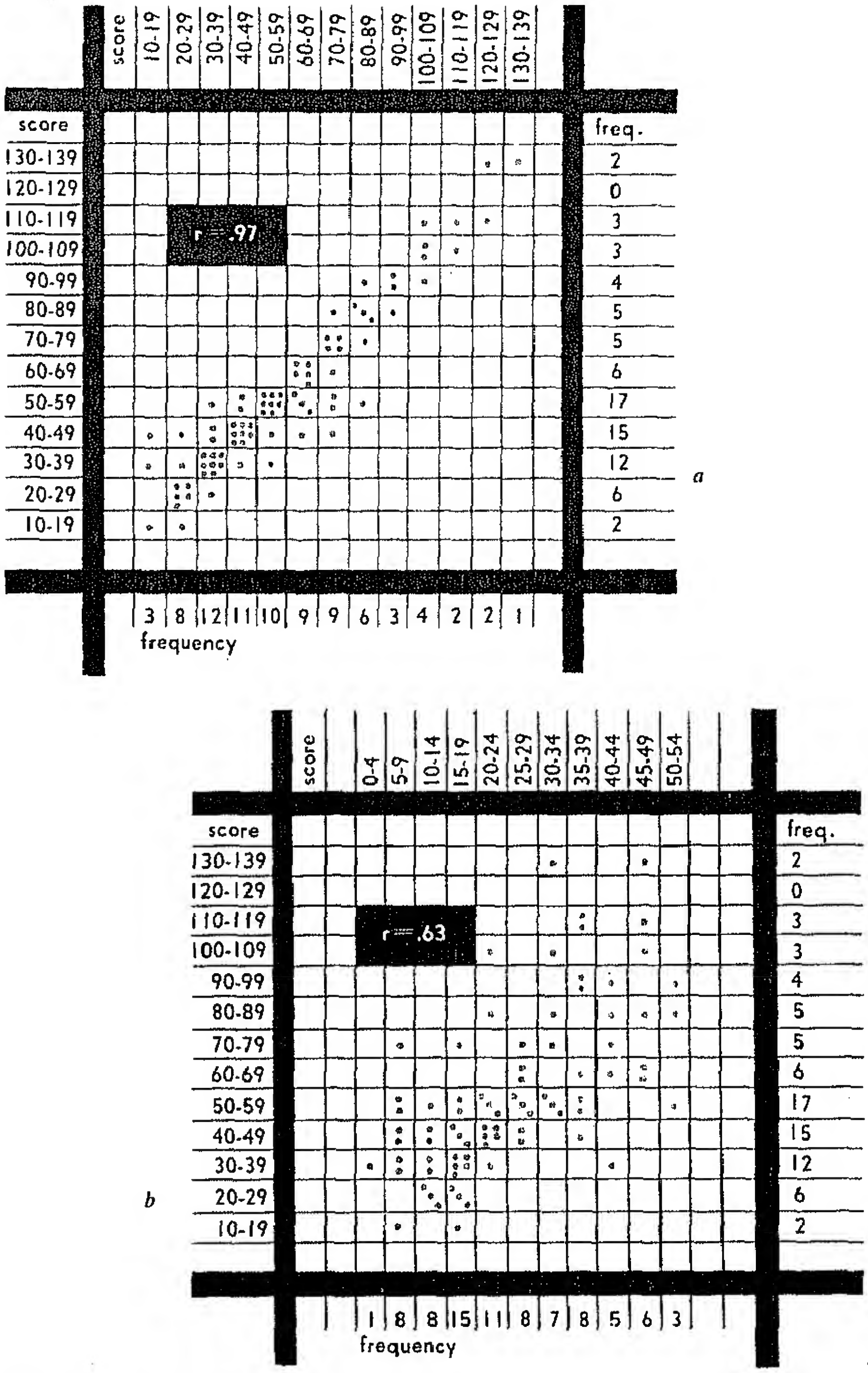
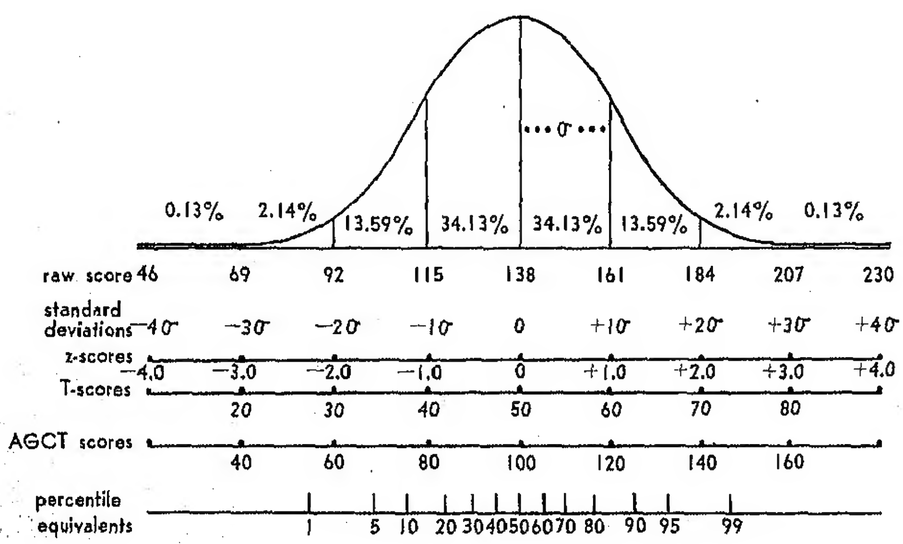


Figure 15.3. Representing correlation coefficients by means of scattergrams. a. *A scattergram of test scores obtained on two different occasions, showing a very high reliability coefficient of +.97.* b. *When the test scores were correlated against an outside criterion, a validity coefficient of +.63 was obtained.*

the reliability of a test is to administer it twice to the same group and correlate the two sets of scores. Figure 15.3*a* shows how correlation data are presented graphically as a *scattergram*. Each point that is plotted on this graph represents one person's test scores on two occasions. Scores from the first test are represented on the abscissa (the horizontal axis), and those from the retest, on the ordinate (the vertical axis). It can be seen that the scores cluster around an imaginary line running from the lower left corner to the upper right corner, indicating a high degree of correlation. A person who made a low score on the first test tended to make a low score on the retest, and so with medium and high scores. If every person had made exactly the same score on both occasions, the plotted points would all fall on a perfect diagonal, indicating a correlation coefficient of + 1.00. The correlation represented in this scattergram is + .97, a very high coefficient.

Figure 15.4. Relation between raw scores, standard scores, and percentiles. Standard scores are based on the standard deviation units of a distribution. Percentile values tell the percentage of scores in the total distribution that lie below the score in question.



Because it is used here to measure reliability, it is called a *reliability coefficient*. If there are alternate forms of the same test, another reliability coefficient can be obtained by correlating the scores of the same group on the two forms. The internal consistency of a test can be measured by dividing the test items into two halves and correlating one half against the other, thereby obtaining the *split-half reliability*.

As we have said, the validity of a test is measured against some outside criterion. Figure 15.3*b* shows a scattergram of the test scores and criterion scores of a standardization group. The *validity coefficient* in this example is + .63. To obtain another measure of the validity of a test, it is given to another group of people similar to the standardization sample and their scores are correlated with a criterion measure. This procedure is known as *cross-validation*. Schools using nationally standardized tests sometimes make cross-validation studies to ensure that the tests are valid with respect to their own school populations.

Standardization of Scores. The test performance of one person is scored in relation to the performance of the standardization group. In order to make the comparison between an individual and the group more meaningful, we convert *raw scores* into *percentile scores* (centile scores) or *standard scores*. Whereas raw scores refer to performance on one specific test, percentile scores and standard scores have general meaning in terms of the normal distribution of human abilities. We have already discussed the difference between raw scores and standard scores in Chapter 2 (see Fig. 2.11). We

learned that *although it is meaningless* to try to compare a person's raw scores *on several different tests, his standard* scores can be compared because each one is a measure of performance in relation to a standard group.

The relations between percentiles, standard scores, and some specific raw scores are shown in Figure 15.4. At the top of the figure we see the familiar normal distribution curve. Along the base line is a range of raw scores with a mean of 138 and a standard deviation of 23. One person's score can be expressed in relation to the total distribution by converting it into a standard deviation value, as shown below the base line. Thus a person who receives a raw score of 161 has a standard deviation score of $+1\sigma$, or one standard deviation above the mean. If we drop the sigma designation, these numerical values are the simplest expression of a standard score, called a *z-score* (line 3). Since z-scores have plus and minus values, it is sometimes convenient to convert them into other standard scores, all of which are positive. One commonly used standard score is the T-score (line 4). The T-score mean is arbitrarily set at 50 and each standard deviation unit equals ten. If we know the mean and standard deviation of the raw scores, we can convert them directly to T-scores. For example, a person with a raw score of 138, the mean, received a T-score of 50. A raw score of 92, which is two standard deviations below the mean, corresponds to a T-score of 30, also two standard deviations below the mean. The Army General Classification Test uses standard scores with the mean set at 100 and the standard deviation at 20 (line 5).

A raw score can also be converted into a percentile value, which tells the percentage of scores in the total distribution that lie below the score in question (line 6). Thus, the mean raw score of a normal distribution is at the 50th percentile, since 50 percent of the scores in the distribution are lower than the mean. A z-score of -1 is equivalent to a percentile score of about 16, since 16 percent of the scores lie below a z-score of -1. Likewise, a z-score of $+1$ is equivalent to a percentile score of about 84. The manual of a test often provides tables for converting raw scores into percentiles, as well as into some type of standard score.

The Use of Tests in Prediction. The use of tests in our society today is a great commercial enterprise, involving each year expenditures of hundreds of thousands of dollars. All of this effort is directed toward a very practical problem—that of predicting the behavior of individuals at some future time. For this purpose tests are used in vocational and educational guidance programs and counseling centers, as well as to select and classify industrial and government personnel. Although tests are useful tools in helping to make decisions in these situations, there are definite limitations on their accuracy as predictors. In general, their accuracy is more limited in predicting individual performance than when they are used as a criterion for selecting groups of people for a particular purpose. To see why this is true, we shall describe several ways in which tests are used to place people in jobs.

Vocational guidance programs usually test individuals on a number of different ability or aptitude tests. When all the

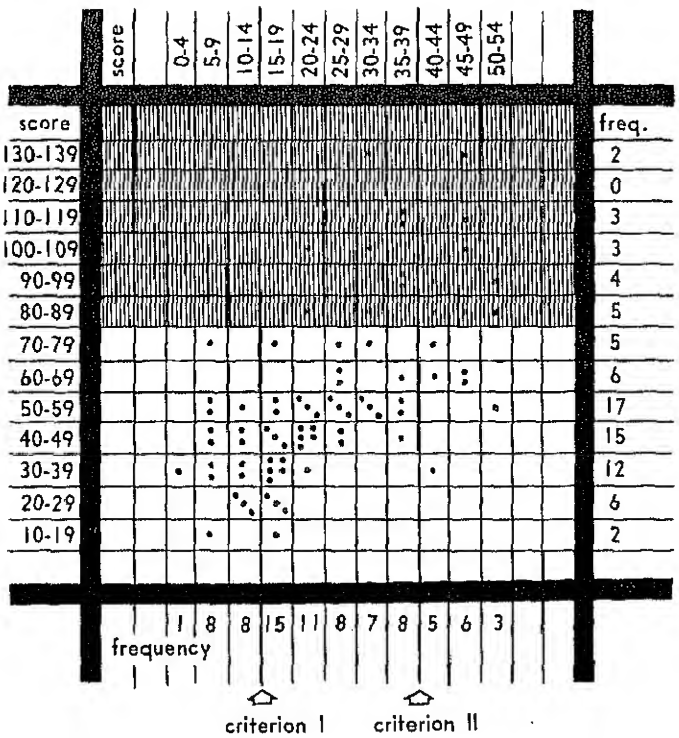


Figure 15.5. The use of tests in group selection. The accuracy of selection of job applicants depends not only on the validity of the test used, but also on the level of the cutting score and the criterion of acceptibility on the job. With the cutting score set at 80, all the selected applicants (in the shaded area) are satisfactory when judged by Criterion I, but not when judged by the higher criterion.

scores are obtained, the counselor tries to match the person's abilities with the requirements of different jobs. Businesses and industries often have testing programs for job applicants using single tests or batteries of tests which have been validated for specific jobs. In this case the accuracy of prediction of individual performance depends on the validity of the test. Usually a somewhat higher validity can be established if more than one test is used. For purposes of individual prediction, we need a test or battery of high reliability, +.80 or more, and a validity of at least +.50, preferably more.

A somewhat different situation exists when tests are used as a basis of selecting a group of people for a given job. Suppose we have a group of job applicants and want to decide which ones to accept. We have a test which has been validated for the job. The scattergram in Figure 15.5 shows the validation data, representing a coefficient of +.63. *Job selection* or *job screening* is a matter of establishing a *cutting score* on the test, as shown by the horizontal line in the scattergram. All applicants testing above the cutting score are selected, while all those making a lower score are rejected (or screened). We can see from the scattergram that the upper group is more likely to be successful in the job than the lower group. Their scores fall farther to the right in the scattergram, representing higher performance scores on the job.

The level at which we set the cutting score might be influenced by several factors. If we have many more applicants than job openings, we can afford to set the score very high and select a group with a very high probability of success. Or, if the job requires a long and expensive training period, such as pilot training in the Air Force, we want to select a group which will include very few failures. The critical thing in selection, however, is the level of acceptability in job performance—that is, the criterion of success or failure. Some jobs have higher standards than others for acceptable work. The two vertical lines in the scattergram show two different criteria of success. If the job is a routine one, the line at the left might define acceptable performance, but if it were more critical our criterion would have to be shifted to the right. Now it will be seen that the cutting score selects a group with high probability of success for Criterion I, not so high for Criterion II. About half the selected group succeeds in terms of Criterion II.

We said above that when a test is used for individual prediction, the accuracy of the prediction depends directly on the validity of the test. However, when a test is used for group selection or screening, the accuracy of the selection process depends not only on the test validity but also on the level of the cutting score and the criterion of acceptability on the job. For any given job, the accuracy of prediction will increase with a higher test validity and with a higher cutting score.

INDIVIDUAL DIFFERENCES IN INTELLIGENCE

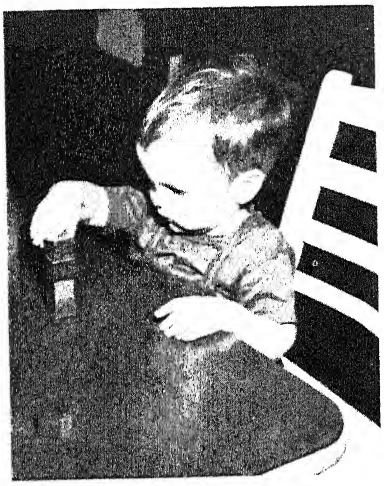
The general group of abilities which we know as intelligence is man's most cherished behavioral characteristic. We recognize superior intelligence in the genius, in the great social leader, in the scientist, or philosopher, or writer. We believe that it is human intelligence that sets man on a higher plane than all other living animals. And yet no one has ever defined precisely what intellectual ability is. When psychologists first tried defining intelligence as "That which an intelligence test measures," some people thought it was a wry joke. However, this definition is still used as a practical statement of a difficult concept.

In more general terms, intelligence refers to a great many human abilities and characteristics of behavior. We associate it with man's capacity for verbal communication, for perceiving complex relationships, and with the ability to think abstractly and to learn rapidly. One aspect of intelligence is man's great flexibility in adjusting to his environment. The superior functional development of the human hand as it is used in making tools, creating, and building, is another aspect of intelligence. No one of these things is intelligence, yet all contribute to it. Intelligent behavior results in the successful solution not only of the problems in an intelligence test but also of many problems of adjustment throughout life.

The standards of intelligence are social standards, set by society in the course of its evolution. In trying to define intelligence and in devising tests to measure it, psychologists recognize the social criteria of poor, satisfactory, and superior performance in adjustive behavior.

The Stanford-Binet Intelligence Tests. It is perhaps ironic that the first attempt to measure intelligence grew out of the problem of how to teach feebleminded children. A young French psychologist, Binet, along with a physician, Simon, developed the first intelligence test in order to identify in the public school population children of very low intelligence.

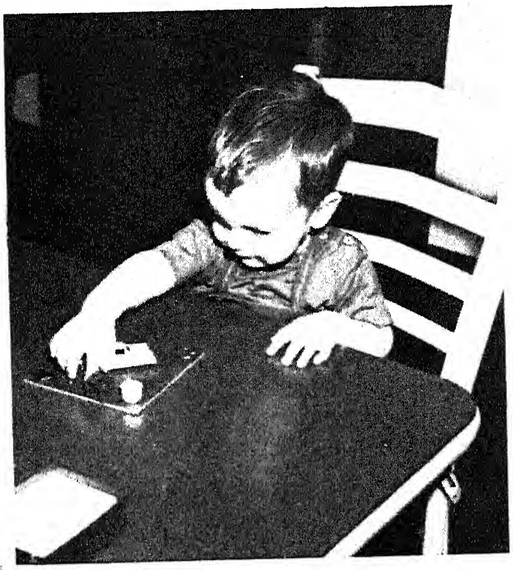
The Binet-Simon tests, which were published first in 1905 and revised in 1911, were designed to give a quantitative measure of a child's intelligence in terms of his *mental age*. The concept of mental age is based on the observation that the intellectual abilities of a child grow as he gets older, just as his height and weight increase. Thus at each level of chronological age there is an average height and weight and also an average mental age, corresponding to chronological age. The test score of an individual was expressed by Binet as his mental age, or M.A. If a child had an M.A. of eight, he did as well on the test as an average child of eight years chronological age, or C.A. A child with a C.A. of six who had an M.A. of eight would be above average



a

Figure 15.6. *Subtests of the Stanford-Binet test. The block-building task is placed at two years, object identification at two-and-a-half years, and this particular bead-stringing task at three years.* (Terman, L. M., and Merrill, M. A. *Measuring intelligence.* Boston: Houghton Mifflin, 1937.)

b



c

in intelligence, while a child with a C.A. of ten and an M.A. of eight would be below average.

The Binet-Simon tests were revised and standardized on American children by Terman and his coworkers at Stanford University. Thus originated the familiar Stanford-Binet scale, which has been used to test American children since it was first published in 1916. A later revision by Terman and Merrill in 1937 is in use today. It has two equivalent forms for testing the intelligence of children from two to sixteen years of age.

The Stanford-Binet scale, like the original Binet-Simon scale, has several subtests at each age level, which can be passed by a child of average intelligence at that age. The photographs in Figure 15.6 show children responding to some of the subtests at preschool levels. In Figure 15.6*a*, the little boy has built a tower out of four blocks, following the example of the examiner. The examiner credits this test at Year II. The same boy is shown in Figure 15.6*b* pointing to objects on the card as the examiner asks, "Show me what we ride in," or "Show me what we sit on." This subtest is placed at Year II-6 (two and a half years). At Year III, the little girl must string four beads in two minutes (*c*). The same materials are sometimes used for tests at different levels, but the tasks are slightly different or the scoring standards are changed. For example, bead stringing is also used at Year VI, but at this level the child must string a particular pattern of beads from memory. A still more difficult bead pattern must be strung from memory at Year XIII.

The procedure in administering the Stanford-Binet scale is to start giving the child subtests at an age level below his chronological age to find a level at which he can pass all the subtests. He is then given the subtests at each successive age level until he fails all of them at one level. His score is determined by finding his *basal age,* the highest age level at which every test is passed, and adding credit in months for all subtests passed above the basal age. A child who passes all tests at Year III, one out of six at Year III-6 and one out of six at Year IV is scored as having the M.A. of three years, two months. From Year VI to Year XIV, the age levels are at one-year intervals so that each of six subtests passed counts for two months of mental age. A child who passes all subtests at Year VI, two at Year VII, and one at Year VIII has the M.A. of six years, six months.

A test based on age levels is limited by the fact that a child's mental development eventually levels off, usually in the

early teens. Thus it is difficult to test adolescents and adults on a scale of this sort. The Stanford-Binet scale has tests for all age levels up to fourteen, and then has subtests at levels called "Average Adult," "Superior Adult I," "Superior Adult II," and "Superior Adult III."

The Meaning of the I.Q. An individual's intelligence as measured by the Stanford-Binet scale is stated as the ratio between mental age and chronological age. This *Intelligence Quotient,* or I.Q., remains more or less constant as the individual grows older. We compute the I.Q. by dividing the M.A. by the C.A. and multiplying by 100 (to eliminate decimals). Thus I.Q. = 100 × M.A./C.A. A child whose M.A. is the same as his C.A. has an I.Q. of 100, which is average. A child whose M.A. is higher than his C.A. has an I.Q. over 100, while a child whose M.A. is lower than his C.A. has an I.Q. under 100.

The graph in Figure 15.7 expresses the I.Q. as a function of mental age, represented on the ordinate, and chronological age, on the abscissa. The stair steps represent the progressive intellectual development of an average child, one whose I.Q. is 100. The two children on the stair steps are of average intelligence, while the one above the steps has an I.Q. above 100 and those below the steps have I.Q.'s below 100. It can be seen that the two children represented on the graph as having a mental age of four and a half have widely differing chronological ages, and thus different I.Q.'s.

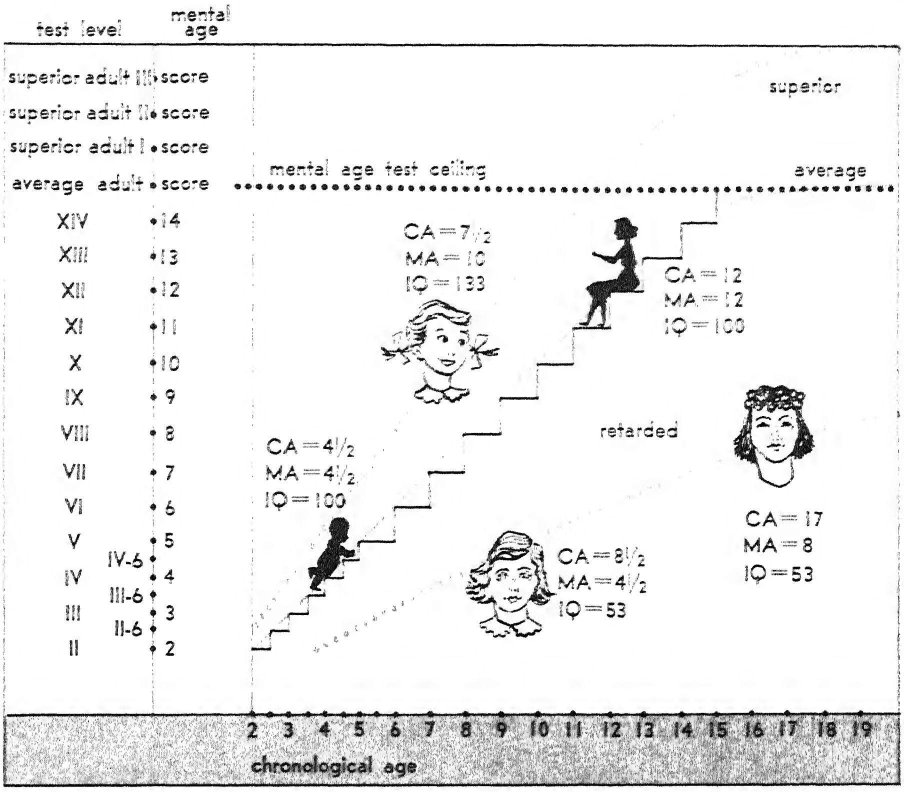


Figure 15.7. The meaning of the I.Q. The intelligence quotient is determined by the relation of the mental age of the individual, as determined by tests, to his chronological age. Since mental development levels off in the teens, the M.A./C.A. ratio does not give a valid I.Q. after about age 15. The Stanford-Binet uses a constant C.A. of 15 for individuals that age and older.

It has been found that when average children are tested with the Stanford-Binet scale at different ages, their I.Q.'s remain much the same up to about thirteen years, after which age the rate of mental development begins to level off. As shown in the figure, the I.Q. curve for average children rises in a straight line along the stair steps to age thirteen and levels off at a mental age of fifteen, or "Average Adult." This means that on the average mental development is complete at fifteen years of age, or, in other words, the M.A. of average adults *as measured by this test* is fifteen. In order to derive fairly meaningful I.Q.'s for persons from thirteen to sixteen years of age, there are special tables provided with the Stanford-Binet test. For persons sixteen and older, a constant C.A. of fifteen is used. Thus the retarded girl in Figure 15.7 with an M.A. of eight and a C.A. of

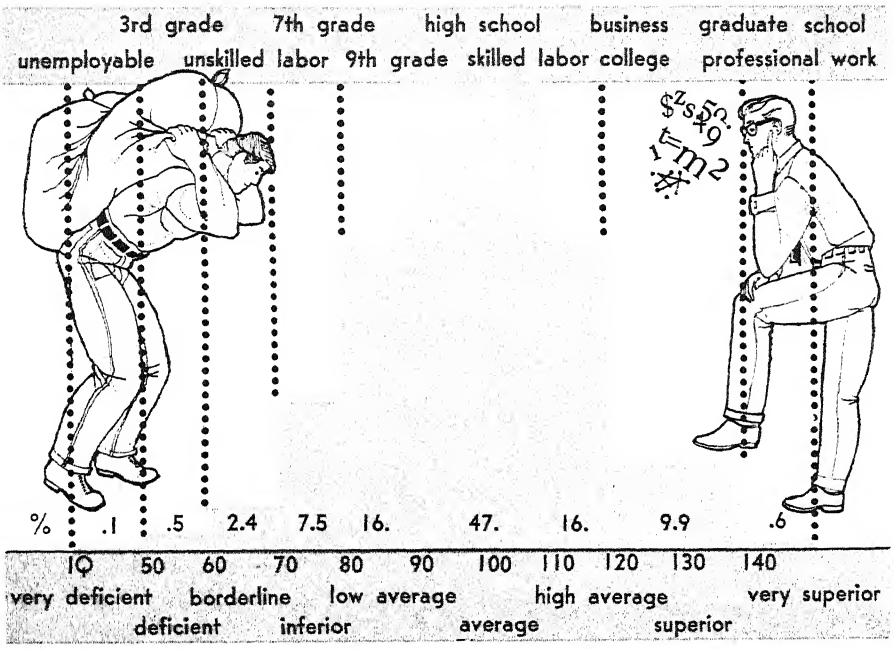


Figure 15.9. Intelligence and achievement. Intelligence is an important factor in determining the course of adjustment throughout life. The level of academic achievement as well as the type of vocation chosen are related to intelligence. [Data adapted from Pressey, S. L., and Robinson, F. P. *Psychology and the new education.* (Rev. Ed.) New York: Harper, 1944.]

istics of behavior. The items on such tests are selected and redesigned to give a maximal isolation of the factors.

Intelligence and Achievement. The overall picture that we get from research programs on intelligence testing is that the level of intelligence, or the I.Q., is closely related to the general adjustment that individuals make in society. The bar graph in Figure 15.9 summarizes the distribution of I.Q.'s in the general population, and shows the level of academic achievement and the type of vocational abilities that can be expected at different levels of intelligence. The groups represented in the graph are designated by generally accepted names, from *Very deficient* at the lower end to *Very superior* at the upper end. Although this distribution is divided into discrete groups, we must remember that there are no sharp dividing lines in intellectual ability among people. One group shades into the next imperceptibly. However, we shall use the classification in Figure 15.9 to point out how patterns of adjustment change with the I.Q.

The tendency of society has been to misjudge the possibilities of both inferior and superior intellects. For example, those people who are generally called "feebleminded" include all those with an I.Q. below 70. We usually differentiate among *idiots,* with I.Q.'s of 25 or below, *imbeciles,* with I.Q.'s from 26 to 50, and *morons,* from 51 to 70. Only the idiots are completely dependent on other people to take care of their routine needs. Imbeciles can learn a little in special classes and can be taught to do simple work under close supervision. However, they are not considered dependable enough for independent employment. Morons include those groups labeled "Deficient" and "Borderline" in our graph. They can be expected to get through several grades in school and perform some unskilled labor. Some people with I.Q.'s of about 70 may be classified "feebleminded" because they are incapable of managing their own affairs; others may be able to achieve independence. The distinction between feebleminded and normal is essentially a social one. In some environments it is easier for the borderline defectives to get along than in others. The importance of social skills in feebleminded individuals is well recognized, and there are tests that measure *Social Age,* as distinguished from Mental Age. In most cases, fortunately, the social age of a mentally deficient person is somewhat higher than his mental age. Thus his ability to get along in society is not as limited as his mental age might indicate.

The great bulk of the population falls in the I.Q. range from 80 to 120. We expect increasing scholastic achievement and more complex vocational abilities as the I.Q. increases. People with an I.Q. of 120 or over are definitely college material.

Human Genius. The development of quantitative measures of intelligence has for the first time in history given us a means of assessing the nature of genius. The very name "genius" has served to set apart from his fellows the individual who attracts attention by his exceptional talents. The genius often has been thought to be in a class by himself, fundamentally different from ordinary men. He has been called insane, degenerate, organically inferior, weak, sickly, unsocial, even feebleminded. Even at best, the genius has been thought ill fitted to adapt to the world he lives in.

These traditional notions of genius have not withstood objective methods of studying superior individuals. The results of intelligence testing have shown that there is no break between the ordinary person and the genius, but that intellectual abilities exist in all gradations from very low to very high. Furthermore, studies of individuals at the upper end of the distribution of intelligence test scores have shown them to be generally superior people, not just in intelligence or some special talent, but in many forms of adjustive behavior.

In Chapter 2 we summarized a monumental study by Terman and his associates of 1300 gifted children in the California schools with I.Q.'s of 140 or over.[1] When these children were first tested, they were generally superior to the average child in physique, health, scholastic achievement, and personality characteristics. Their careers as they were followed through the years fulfilled the early promise. As adults, these gifted individuals were successful in their jobs and remarkably well adjusted in their personal lives. Of course there were exceptions to the rule, but, in general, superior intelligence went hand-in-hand with superiority in other adjustive characteristics.

Another approach to the study of genius is to trace the mental development of gifted historical figures through biographical material and other information relating to their childhood abilities. In this way the I.Q.'s of many famous men have been estimated by comparing accounts of their early performances with the standard age norms of intelligence tests. Francis Galton and Goethe have been estimated to have had an I.Q. of 200, Galileo of 185, Dickens of 180, and John Quincy Adams and Mozart of 165.[2] These eminent men displayed exceptional abilities in early childhood and went on to outstanding achievements in many walks of life.

The Limiting Factors in Intelligence. There have been numerous attempts to assess the relative importance of heredity and environment in determining the level of intellectual ability. As we indicated in Chapter 5, it is generally agreed that the genetic make-up of an individual sets an upper limit to his intelligence, but in order to realize his potentialities he must have the advantages of a favorable physical and physiological environment. Furthermore, his social and cultural environment should provide him with opportunities to develop according to socially approved standards.

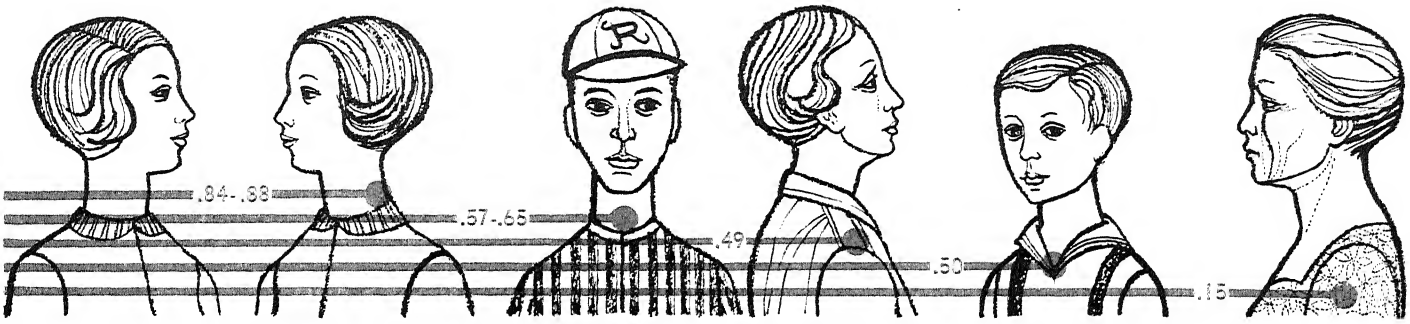


Figure 15.10. Family correlations in intelligence. Some typical correlations which might be found between the girl on the left and her identical twin, fraternal twin, parent, sibling, and grandparent. [Data from Jones, H. E. The environment and mental development. In Carmichael, L. (Ed.) *Manual of child psychology.* (2nd Ed.) New York: Wiley, 1954. Pp. 631–696; Woods, F. A. *Mental and moral heredity in royalty.* New York: Holt, 1906.]

Family similarities and differences in intelligence. The importance of the hereditary factor in intelligence is seen in the general positive correlations that exist among blood relatives. Figure 15.10 shows some typical correlations which might be found between a child and his identical twin, fraternal twin, parent, sibling, and grandparent. In general, as the family relationship becomes more distant and the likelihood of genetic similarity decreases, the correlation between intelligence test scores also decreases. The only exception is in the case of fraternal twins, who, although they are no more similar genetically than other siblings, show a higher correlation in I.Q. scores. This is interpreted as being due to the fact that the environments of twins are more similar than those of siblings of different ages.

If heredity were the only definitive factor in intelligence level, identical twins should show identical I.Q.'s. The less than perfect correspondence between them is further evidence that environmental factors can influence intelligence. In Chapter 5 we reviewed a study of identical twins who had been separated in childhood and reared apart. The significant finding was that marked differences in measured intelligence were found in several pairs who had been brought up in dissimilar environments.

One means of comparing hereditary and environmental influences is to study the performance of foster children. It has been found that the intelligence of foster children correlates more highly with their true parents than with the foster parents with whom they have lived since infancy.[3, 4] However, the correlation of foster children with their true parents is somewhat less than for children who live with their true parents. Furthermore, foster children who have been removed from poor environments to superior foster homes show average increases in I.Q.'s of from five to ten points.[4, 5] Here again the data suggest that within limits set by hereditary factors, measured I.Q.'s can vary according to environmental conditions.

Racial and cultural differences. Many people believe that different races of man differ fundamentally in intellectual ability. The American white person often considers himself biologically superior in intelligence to the Negro, or the American Indian, or certain foreign groups. It is very difficult to compare racial groups in intelligence for a number of reasons, some

of which we have pointed out previously.

In the first place, there is always the problem of the validity of intelligence tests for different groups. As we have said, a test which has been standardized on a group of white, native-born American children is not a valid instrument for testing other racial and cultural groups. As yet we have no internationally valid test with which we can test people of any race, in any place, although there are some performance tests designed specifically to minimize differences due to language and general training.

Then, too, we know that changes in the environment during early childhood can produce real shifts in I.Q. scores. The foster children studies tell us that. Further, there are studies which show that children who have moved from rural communities to cities have higher intelligence test scores the longer they have lived in the cities.[6] Some studies have reported increase in I.Q. level in children who have been given improved educational opportunities, although these results are not entirely unequivocal.

The question of whether there are differences in intelligence among racial and cultural groups depends upon the meaning and interpretation of test scores. We conceive of intelligence as a human capacity, or potentiality, for the kinds of adjustive behavior that society considers intelligent. Yet it is impossible to test and measure capacities or potentialities as such. All we can measure, and all we do measure with our intelligence tests are human abilities—kinds of behavior that individuals can perform at present. Those people who have had limited opportunities to acquire knowledge and practice various skills are inevitably at a disadvantage in a test situation. Furthermore, the individual who does not "know how" to take a test, or who is frightened, or disturbed, or rebellious in the test situation is also at a disadvantage.

At the present time there is no clear evidence that "true" racial differences in intelligence exist. The measured differences can be attributed to inadequacies in our tests, or differences in environmental opportunities, or both.

HUMAN MOTOR ABILITIES

Many human activities are defined by the quality of motor skill that characterizes their performance. We describe the people we know as clumsy or graceful, well or poorly coordinated, strong or weak, skilled or unskilled. Upon what factors in human behavior are these judgments based? How can we describe the motor abilities?

Motor skill, like intelligence, is not a single ability but involves a number of factors. We recognize skills of many kinds—in athletic abilities, in artistic creations, in machine operation and tool using, and in many other kinds of highly coordinated behavior. Some of these skills are shown in Figure 15.11, where we see the graphic skill of the young artist, the rhythmic bodily skills of the dancers, athletic skill, and the machine-structured skill of the worker.

One of the problems in describing motor skill is to differentiate the primary abilities which contribute to performance. In ordinary conversation we say that one individual has "athletic ability," that another is "clever with tools," that another is "well coordinated." However, when we try to analyze motor skills with instru-

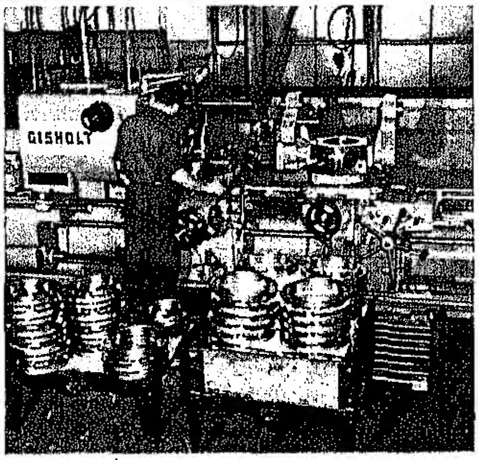
Figure 15.11. Kinds of motor abilities. Motor ability involves many different factors, some of them quite unrelated to each other. The skills illustrated are highly precise spatial and temporal coordinations of movements. (*a*, courtesy Cameron McCauley; *b*, Carl A. Stapel; *c*, Madison, Wis., Board of Education; *d*, Gisholt Machine Co.)

a

b

c

d



ments and tests, we see that these general descriptions do not define the basic dimensions of movements. Athletic ability is not a unitary skill, but depends upon a number of different factors. A boy who is a good football player is not necessarily good at tennis, although he may have abilities which contribute to excellence in both of these sports.

The skilled movements pictured in Figure 15.11 have some features in common which help us to understand the general nature of motor abilities. All of them involve a high degree of *precision* in adjusting movements to the spatial characteristics of the environment. All of the skilled movements can be described in terms of the *force* behind them, and their *magnitude*. Each movement is characterized by its *timing*. Finally, the skills represented are spatial and temporal *coordinations* of their component movements. The dancers in particular show a rhythmic coordination patterned in space and time.

The skill of the machine operator is defined by his individual movement abilities in relation to the properties and dimensions of the devices which he must operate. In one sense he is a part of a machine. In much the same way that man's verbal abilities are organized around a language of his own making, many of his motor abilities are structured and integrated by his tools, instruments, and machines. There is a continuity between the earliest grasping and manipulation movements of the child and the highly organized mechanical and artistic skills of the adult. Our standards of motor performance are based for the most part on skill in manipulating the man-made environment.

As a working definition, we can say that motor skill is the ability of the individual to control the force, accuracy, timing, and magnitude of his movements to produce patterns which are coordinated in space, in time, and with relation to tools and machines. The measurement of motor abilities, like the measurement of intelligence, is a relative procedure based on social criteria of performance. A scientific understanding of how the body is organized as an action system helps us in understanding the requirements of different kinds of work and play activities, in increasing efficiency, and in cutting down the accident hazards in all types of machine operation.

The full implications of the analysis of motor skills become apparent when we study the psychological factors involved in the design and development of elaborate and costly military and industrial machines. Such analysis may mean the difference between a gun system in a heavy bomber that is nearly useless and one that is highly effective. An error in assessing the skills involved in flying a jet plane can mean an intolerable increase in the hazards imposed on the pilot of a multimillion-dollar machine.

Manual Tests of Motor Ability. Many types of tests have been devised to measure the different aspects of motor skill. Figure 15.12 shows a number of such tests used to measure reaction time and manual dexterity.

The apparatus in Figure 15.12*a* measures simple reaction time to a light which is presented on the vertical panel. The subject responds by pressing the button on the base plate, and the time between stimulus and response is recorded on a time clock. The O'Connor Finger Dexterity Test (*b*) and the Purdue Pegboard (*c*) measure both speed and accuracy of movement. Pins or pegs are picked from the attached bins and placed in the holes. The performance score is the number of pins placed in a given period of time. The punch board test (*d*) also measures precision and speed, but there are no long arm movements required for this task. The performance score is the time required to punch with the pin all of the holes in the board in order.

Paper and Pencil Tests of Motor Ability. We use paper and pencil tests of motor skill when we need to test a number of people at the same time. The two tests shown in Figure 15.13 are both speed tests from the MacQuarrie Test of Mechanical Ability. In the tapping test, the subject must put three dots in each of a series of circles covering a page. In the dotting test, where the circles are smaller and irregularly placed, the subject puts only one dot in each circle. Such paper and pencil tests of motor ability can be made more complex in order to measure other aspects of skill, such as steadiness or complex reaction time.

The Nature of Motor Ability. Our tests of intelligence are designed to measure individual capacities or aptitudes to act intelligently in many different life situations. These tests are reliable, and also fairly valid in predicting successful performance in many different areas. When we study motor abilities, the problems and procedures are quite different. Except for the very simplest measures of skill, our tests of motor abilities are not very reliable. Individual performance is

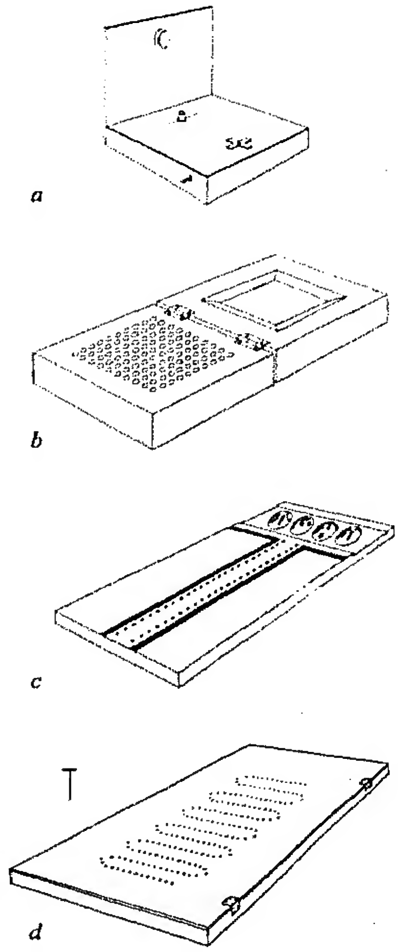


Figure 15.12. Manual tests of skill. There are many tests to measure different aspects of motor skill. Those shown here are a test of reaction time, a, *two tests in which subjects place pegs in holes,* b *and* c, *and a punch board test,* d. (Courtesy Dr. Edwin A. Fleishman; *b*, C. H. Stoelting Co.; *c*, Purdue Research Foundation and Science Research Associates.)

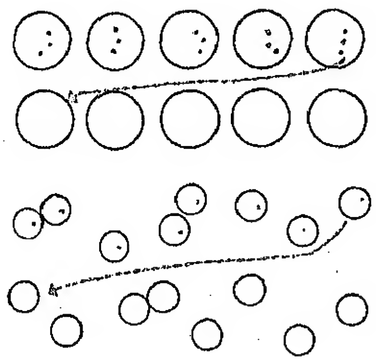


Figure 15.13. Paper and pencil tests of motor ability. These tapping and dotting tests are of precision and speed. (Adapted from the MacQuarrie Test for Mechanical Ability, California Test Bureau.)

not consistent from one time to the next. Furthermore, motor tests have such low validity coefficients that they are not very useful in predicting individual performance.

The problem in testing motor abilities is that all of the significant human skills are highly specific,[7] bear little relation to each other, and can be maintained at a constant level only through practice. The useful social skills are for the most part learned activities, and our predictions of individual performance in any given skill are not very accurate. Athletic coaches cannot pick out potential athletes with any degree of success, nor can we select those individuals in advance who will make highly successful typists, or piano players, or painters. These complex skills cannot be predicted well, but can be measured only after they have been learned to some degree. Even the simplest tests of motor skill are likely to show practice effects, which contribute to the unreliability of the measurement. Motor performance also varies with motivation, emotion, and the general physiological condition of the performer far more than does performance on intelligence tests.

The learning of a complex skill may take years of practice, and further practice is necessary to maintain it. A learned skill is apparently never forgotten completely, but, on the other hand, only constant use can keep it at a high level. Skilled performers of all kinds get "rusty" without practice. This is as true of artists as of athletes, or of skilled workers. Many motor skills—even those requiring a fair amount of strength and agility, such as tennis, ice skating, or wrestling—can be continued into old age if they are practiced regularly.

SPECIAL APTITUDES AND VOCATIONAL CHOICE

Intellectual and motor abilities do not tell the whole story of human abilities and skills. Another attribute of great significance in society is artistic or creative ability, the kind of behavior we often call "talent." There is much overlapping in all of these areas of human behavior. Some of the more specific factors which contribute to intelligence also contribute to motor ability. The artistic talents also draw heavily on intellectual and skill factors. Some highly endowed individuals are superior in intelligence, motor ability, and one or more creative abilities, while other persons are inferior in everything. Yet there is, in general, no close relationship among different types of abilities. If we test a single individual with a number of different types of tests, we see that he can vary greatly in performance. The overall picture of his aptitudes and skills not only helps define him as a personality but helps determine the course of his life adjustment (see Fig. 15.14).

Variation in Abilities within the Individual. Perhaps the most extreme cases of trait variation within the individual are those rare persons known as *idiots savants* (wise idiots).[8] Occasionally, a person who is generally dull, or even institutionalized as feebleminded, will show an exceptional talent in some specific ability. The name *idiot savant* is not particularly appropriate, since these people are not true idiots as defined by I.Q., nor are they wise in the sense of being intelligent. Their particular skill is usually a very specific one not closely related with verbal intelligence. It may be a phenomenal memory,

a talent for music, or drawing, or painting, mechanical skill, or, in some striking cases, an almost incredible facility in handling numbers and performing complicated mathematical calculations without using paper and pencil.

The variation in abilities in ordinary individuals is not so extreme, yet it is often easily recognized. We all know people who are generally intelligent but who "can't add two and two," or others who cannot get along in school but are talented in music or art. Some children who have no interest in academic subjects show a high degree of mechanical aptitude. Casual observation tells us something about our strengths and weaknesses, but not enough. In order to make wise decisions about schooling and the choice of a vocation, we need the kind of quantitative information that is provided by standardized tests of many kinds.

We have already said a great deal about intelligence tests and some of the tests of motor ability. In this section we are going to summarize some other types of aptitude tests and show how an analysis of the individual is used to guide vocational choice.

Musical Aptitude. The first tests designed to measure musical ability were the Seashore tests, which appeared in 1919 and were revised in 1939. They consist of a number of phonograph records which present variations in pitch, loudness, time, rhythm, timbre, and tonal memory. Each series of tones varies in only one component. The listener judges which tone is higher, in the case of pitch discrimination, or which is louder, and so on. Other tests of musical talent have also been designed to measure different

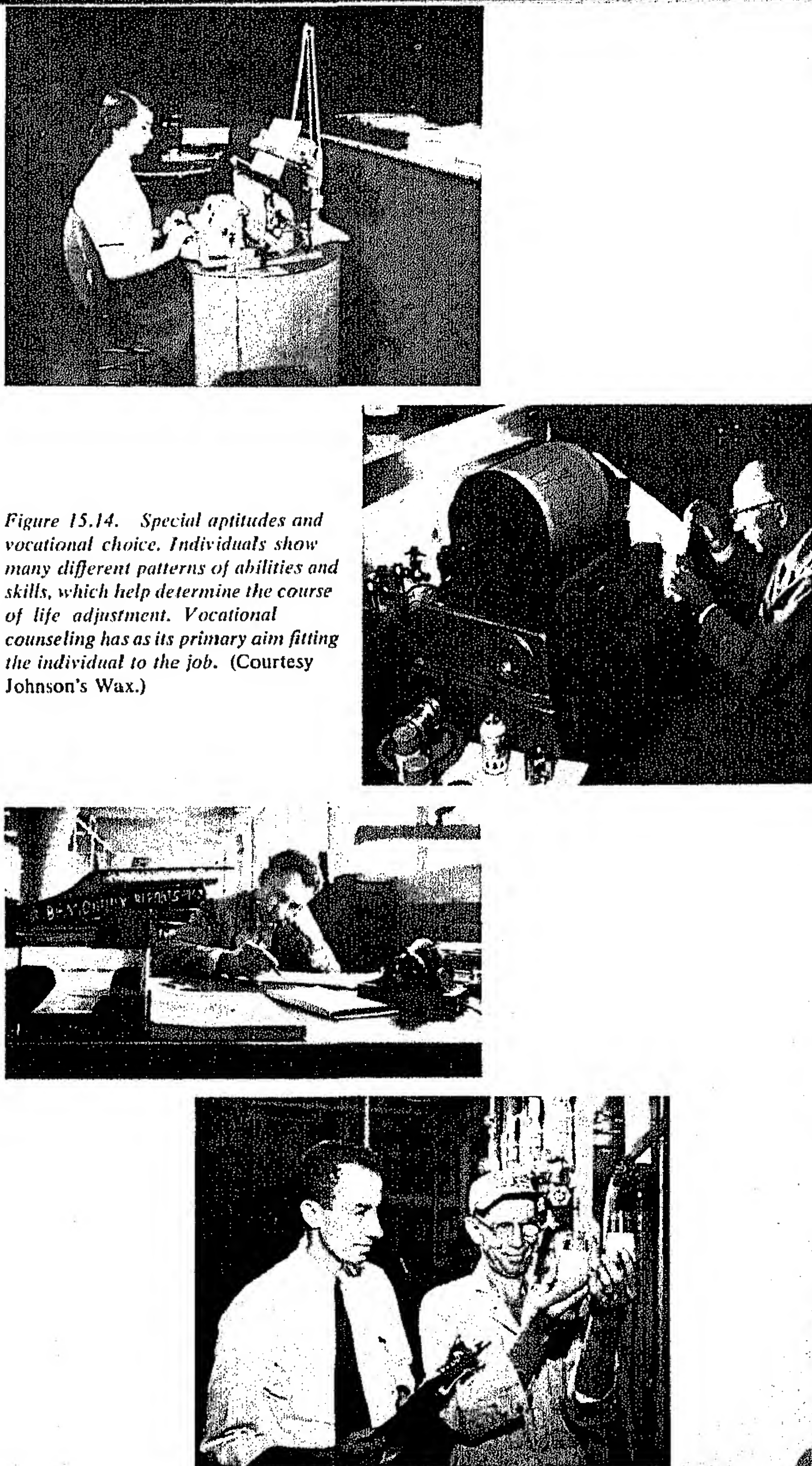


Figure 15.14. Special aptitudes and vocational choice. Individuals show many different patterns of abilities and skills, which help determine the course of life adjustment. Vocational counseling has as its primary aim fitting the individual to the job. (Courtesy Johnson's Wax.)

component factors. Good musicians are not necessarily superior in all of these abilities.

Although the use of musical tests has been limited by their generally low validities, the Seashore tests when given along with an intelligence test proved useful in predicting the varying success in music school of a group of entering students.[9] However, none of the tests of musical talent is valid enough to predict individual achievement in music with any degree of accuracy.

There is a positive correlation, but of a low order, between musical ability and general intelligence.[10] Scores on the Seashore tests when correlated with both intelligence test scores and achievement scores produced correlations not exceeding +.26.

Artistic Aptitude. *Although the factors* making up artistic talent are not clearly defined, there are a number of tests which purport to measure different aspects of artistic aptitude. One analysis names craftsmanship aptitude, volitional perseveration (defined as motivation to do excellent work), esthetic intelligence, perceptual facility, creative imagination, and esthetic judgment.[11] Since these factors have not yet been defined in valid behavioral terms, we can hardly evaluate their significance. Artistic appreciation and judgment are so subjective in nature that this is a particularly difficult field in which to design tests or do research.

The first factor named above, craftsmanship aptitude, is considered to be due in part to hereditary factors. The number of craftsmen in the ancestry of artists and art students was shown to be more than twice that for unselected students. Groups of artists and art students had on the average four to five craftsmen in their ancestry, while unselected students had two. However, children who are brought up in families where fine craftsmanship is admired obviously are subject to selective environmental effects as well as hereditary. It is undoubtedly true that some artistic talents, including some musical abilities, "run in families," but beyond this we can say little.

Mechanical Aptitude. The popular notion that some people who are not very intelligent may be superior in mechanical ability is well substantiated by testing and research. An extensive study carried out in Minnesota on various tests of mechanical ability found six which correlated highly with each other and also with outside criteria of success in jobs requiring mechanical skill.[12] However, there was no significant correlation between scores on these mechanical ability tests and intelligence test scores.

Several kinds of mechanical aptitude tests are used in vocational guidance and job placement. We have already described some of the common tests of manipulation and manual dexterity (Figs. 15.1*d* and 15.12). Spatial relations or "form board" tests require the individual to fit pieces of wood of various shapes into the proper holes as quickly as possible. A paper-and-pencil adaptation is the Minnesota Paper Form Board (Fig. 15.15*a*). Some performance tests of mechanical aptitude consist of very specific tasks. The Minnesota Assembly Test provides the parts of common articles to be put together as quickly as possible. Some of the articles used are a safety razor, a spark plug, a monkey wrench, and a

mousetrap. Still other tests sample the individual's mechanical comprehension or knowledge (Fig. 15.15*b*).

Analyzing the Individual. The variety of tests available to the vocational counselor enables him to analyze the abilities of an individual along many different lines. There are intelligence tests of several kinds, mechanical, musical and artistic aptitude tests, as well as tests in a number of other vocational skills, such as clerical aptitude. Other important characteristics of individual behavior which are as important in some jobs and professions as intelligence or special abilities are social skills and personality characteristics. In the next chapter we shall describe some of the well-known personality tests.

To guide an individual in the choice of a vocation or profession, it is important to know his interests and attitudes toward different types of work. Vocational-interest tests provide a means of pretesting a person's liking or disliking for different occupations. The Strong Vocational Interest Blank determines the similarities between a person's interests and those of people who are successfully engaged in specific professions. The person taking the test indicates his preferences for a great many items having to do with occupations, amusements, school subjects, and personal peculiarities. His overall interest pattern is then scored separately for each occupation in which a rating is desired. There are scales for 39 men's and 18 women's occupations, which show the interests of people known to be successful in those fields.

Other interest tests attempt to measure directly a person's likes or dislikes for the activities or tasks involved in different occupations. The Kuder Preference Record, for example, obtains interest scores in nine areas: mechanical, computational, scientific, persuasive, artistic, literary, musical, social service, and clerical. There are a number of occupations listed for each area, but the classification is not completely valid, since the test has not been validated for every occupational group listed.

The principal weakness of interest tests is that interests often do not reflect ability. Furthermore, the occupational interests of an adolescent or young adult do not always provide a reliable criterion of future success. Perhaps the most valuable contribution of interest tests is to suggest vocations to the young person whose plans are in the formative stage. The Strong Interest Blank, since it is standardized in terms of successful occupational groups, can strengthen an individual's occupational choice if he shows a high interest score for that occupation, or discourage a choice where the interest score is low. Some people choose their vocations because of family pressure or the prestige value of the vocation. In a case like this, ability and interest scores combined indicate whether the choice is a wise one.

Various combinations of aptitude, personality, and interest tests are used in schools and colleges to counsel individuals in vocational choice, and in industry as a guide in the selection and placement of personnel. All of the test scores for an individual may be represented on a profile, where they are expressed either as standard scores or percentiles. In Figure 15.16 are two actual profiles from the files of an industrial personnel depart-

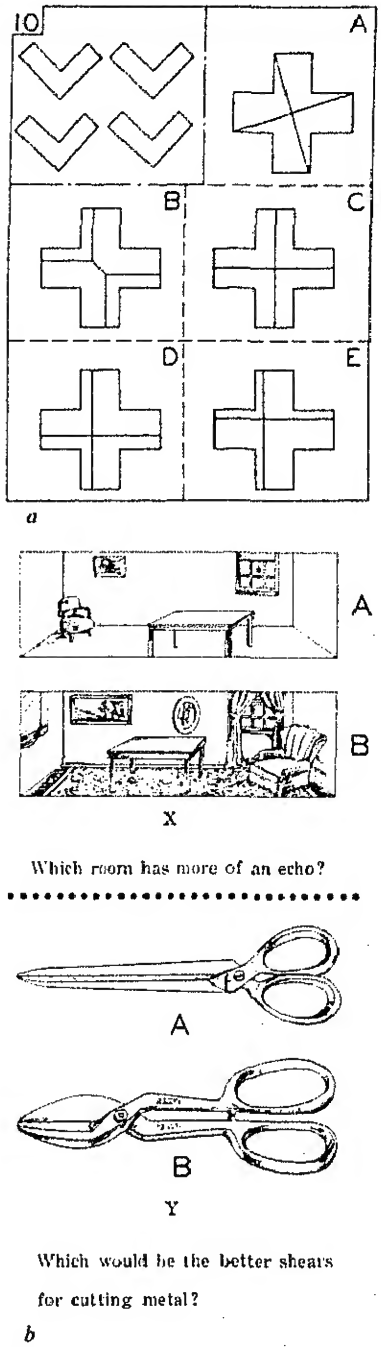


Figure 15.15. Mechanical aptitude tests. a. *In the Minnesota Paper Form Board, there are a series of problems in which the subject selects the pattern made up of the separate parts.* b. *Mechanical comprehension test items.* (Courtesy the Psychological Corp.)

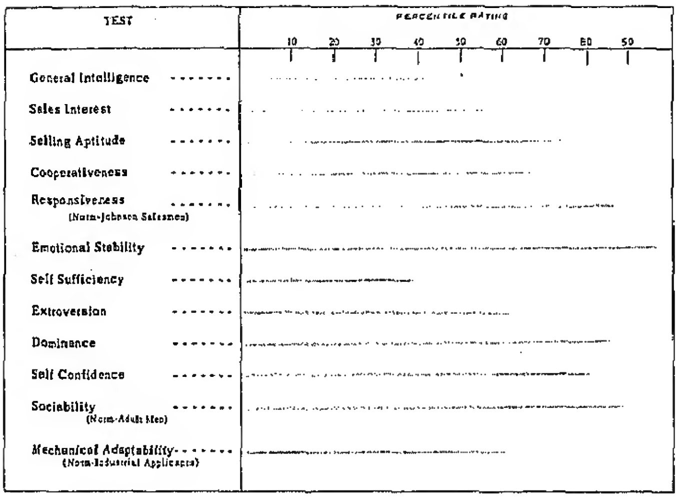
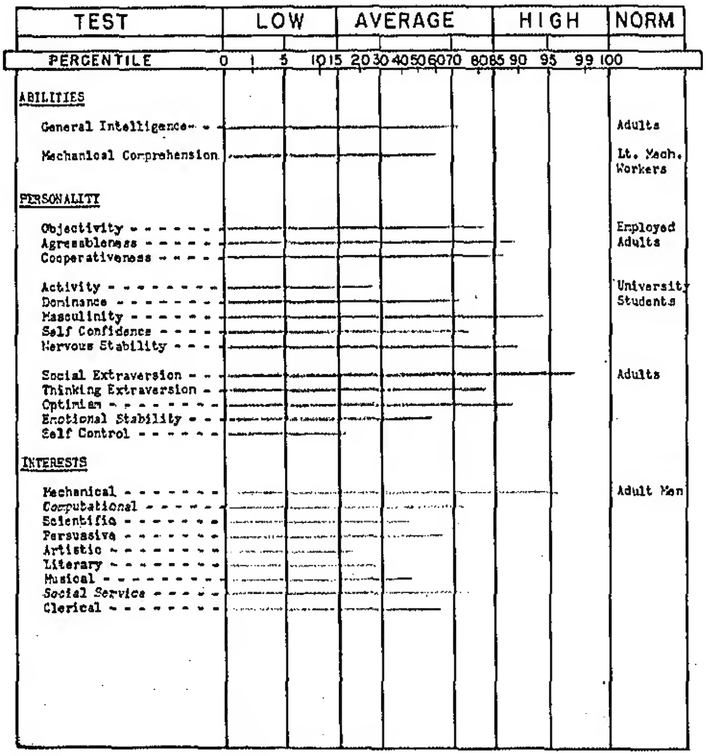


Figure 15.16. Psychographic profiles used in selection and placement. Different test batteries are used to predict achievement in different types of jobs. Each battery shown here includes a general intelligence test, interest tests, personality tests, and tests of special aptitudes. (Courtesy Johnson's Wax.)



ment. Notice that each profile is made up of a *different battery of tests*, designed in each case for its usefulness in predicting achievement in different types of jobs.

A relatively new development in industrial psychology is the construction of test batteries specifically designed for job placement and validated for many different jobs. One such battery is the General *Aptitude Test Battery of the United States* Employment Service, which includes fifteen tests designed to measure the following ten aptitudes: general intelligence, verbal aptitude, numerical aptitude, spatial aptitude, form perception, clerical aptitude, aiming, motor speed, finger dexterity, and manual dexterity.

Fitting the Individual to the Job. The practical success of vocational guidance and placement depends on how well the analysis of individual abilities can be matched to the requirements of a job. For this purpose there are two types of information available about jobs. First, there are validation data for tests or groups of tests in relation to particular jobs. Second, there are job analysis data showing the *abilities* used in a specific job.

Some of our standard tests of aptitudes have been validated for many different occupations. The General Aptitude Test Battery of the United States Employment Service has validity data available for many specific industrial jobs. In some cases the whole battery is used to predict *success in a job, while in other cases those* tests are chosen which have the highest predictive value. As an example, four tests from this battery, Form Matching, Placing, Assembling, and Disassembling, were used by an industry in cooperation with a state employment service to pre-

dict the performance of girls who tie casting flies for fishermen. The coefficient of validity in this situation was +.49.[13] In another study, a group of bank tellers were tested on parts of the GATB and their scores validated against on-the-job performance as rated by supervisors.[14] The validity coefficient in this case was found to be +.55.

A complete job analysis is a description of the duties and conditions of a job as well as the human abilities, training, and experience which are necessary to perform the duties. The United States Employment Service launched a large scale research program in the early 1930's to define and describe specific jobs and to develop techniques of worker selection. The latest edition of the U.S.E.S. *Dictionary of Occupational Titles* defines about 42,000 jobs by giving a brief, general description of what the job is and its principal intellectual and physical requirements. In addition to compiling the dictionary, the U.S.E.S. research program has prepared many relatively complete job descriptions, giving all the pertinent data about the work performed, necessary equipment, and the training and experience necessary. At the present time, the U.S.E.S. describes jobs by analyzing the worker trait requirements necessary for each job, including requirements in aptitudes, interests, temperament characteristics, and so forth. These trait requirements are determined by trained analysts working in the various state employment services throughout the country. About 4000 jobs have been described in this way and published by the U.S.E.S. for the use of the state employment services.

Another method of job analysis is to draw up job ability patterns by testing occupational groups on standard tests. Thus a profile can be drawn which shows the average test scores characteristic of workers already engaged in an occupation. By classifying workers as inferior or superior, two profiles can be drawn for the job, characterizing each group. These ability patterns have limited significance because of the great variability of test scores in any occupational group and the overlapping which is found among different occupations. They can be used mainly to point out to an individual whether or not any of his own test scores are significantly inferior to an occupational average.

Vocational counseling and job placement have varying degrees of success. The use of standardized tests can sometimes point the way to satisfactory vocational adjustment, but their value is limited by the fact that the more elusive qualities of personality which are so important in defining the course of adjustment resist measurement and analysis. In the next chapter we shall turn to a consideration of the problems of personality measurement.

SUMMARY

Psychological tests measure differences in abilities and behavioral characteristics among people by sampling behavior. An achievement test is used to test level of achievement in a particular knowledge or skill; an aptitude test attempts to measure potential ability.

To be dependable and useful, a test should be reliable and valid; that is, it should give consistent measurements, and measure what it intends to measure. To standardize a test, it is given to a standard

population to establish norms, and then specific measures of reliability and validity are determined. Individual raw scores are converted into standard or percentile scores.

When a test is used to predict individual performance, the accuracy of the prediction depends on the validity of the test. When it is used for group selection, *the accuracy of selection depends on test* validity, the level of the cutting score, and the criterion of acceptability on the job.

The Stanford-Binet intelligence scale consists of subtests grouped at mental age levels, designed to test children and adolescents. The I.Q. is determined by dividing the mental age by the chronological age times 100. The Wechsler adult scale has different norms for each age group of adults, *and yields deviation* I.Q.'s.

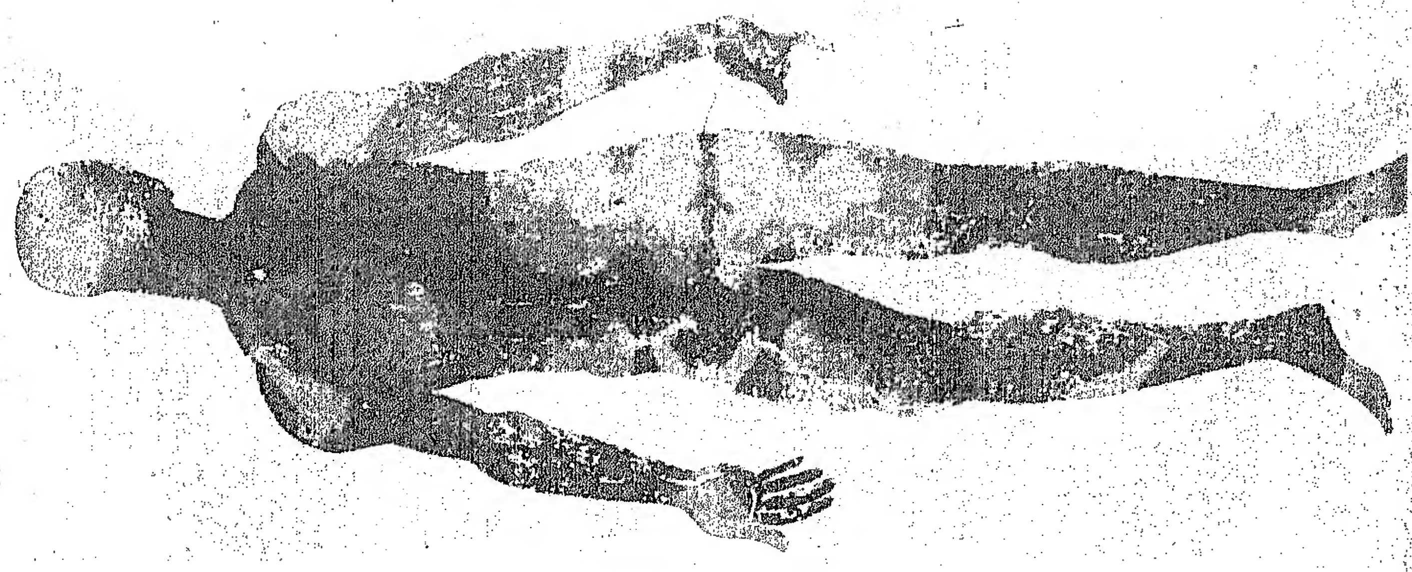
Intelligence is made up of a number of more or less specific abilities and may also include a general factor.

The level of intelligence is closely related to the general adjustment that individuals make in society. Highly intelligent people in general make superior adjustments.

Genetic make-up sets an upper limit to intellectual ability, but a favorable environment is necessary for the individual to realize his potentialities. There are probably no basic differences in intelligence among the different races, but cultural opportunities affect both development and test performance.

Motor skill is the ability of the individ*ual to control the force, accuracy, timing,* and magnitude of his movements to produce patterns coordinated in space, in time, and with relation to tools and machines. Tests of skill are neither very reliable nor valid. Skills are highly specific and practice is necessary in order for them to be maintained at a constant level.

There is no close relationship among *different abilities, and individuals show* many different patterns which should be considered in vocational choice. Test scores of intellectual, motor, musical, artistic, mechanical, and other abilities, combined with interest and personality test scores, enable the vocational counselor to fit the individual to the requirements of a job.



CHAPTER 16. PERSONALITY MEASUREMENT

Since primitive man first evolved an awareness of himself as a distinct being, people have been striving to understand themselves and to achieve insight into the personality of others. This striving is part of the fear and anxiety about the unknown, about the meaning of life, and about the catastrophes which can occur through accident, injury, and disease. One of the most universal interests in psychology is to understand one's own self, one's own personality.

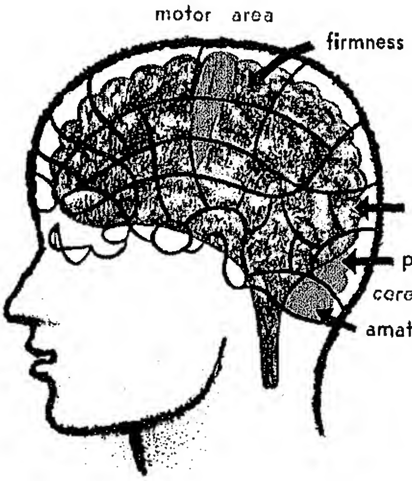
Every age has had its own systems of understanding personality. Primitive cultures often have believed that individual actions are subject to control by outside forces—gods or demons, good or evil spirits. Thus, acts of heroism might be attributed to a god, while disordered behavior could be blamed on the influence of an evil spirit. The pseudoscience of astrology, which has persisted for many centuries down to the present day, is based on the notion that individual behavior is influenced by the movements of the planets. In contrast to these beliefs that human lives are molded by external forces beyond individual experience, there are other theories that attribute personality characteristics to some circumstance or set of circumstances within the individual. Many systems have been devised to classify the people of the world into personality types, and to identify the "something" in each individual that makes him the distinct person he is.

PERSONOLOGY

The classifications of personality types have a certain fascination for us, even when we realize their inadequacies. It would be so convenient if we were able to sort out our friends and enemies into neat categories and deal with them accordingly. One of the earliest classifications was developed about 400 B.C. by Hippocrates, who divided people into four types according to the four "humors" or fluids of the body: blood, black bile, yellow bile, and phlegm. This theory has found a permanent status in our language, for we still speak of the sanguine, melancholic, choleric, and phlegmatic temperaments.

We are going to describe Hippocrates'

Figure 16.1. A phrenological map of the skull. According to phrenology, personality is made up of separate faculties, each of which resides in a separate area of the brain. Thus a bump on the skull would indicate a highly developed faculty underneath. The colored areas superimposed upon this map indicate some of the functional areas of the brain as we know them today.



system and several later ones as theories of "personology,"[1] to distinguish them from the more restrained and objective studies and descriptions of personality which we shall discuss later. Systems of personology have been very serious attempts to understand human personality, and are often based on demonstrable variables in the structure or function of the human system. They have failed, however, to advance the scientific description of human behavior as it is expressed in the individual. After considering some of these systems briefly, we shall try to see why they have failed.

Phrenology. If Hippocrates' emphasis on body fluids foreshadowed our modern interest in the chemical regulators of behavior—that is, the hormones—then our interest in the brain was preceded by a curious system of character reading known as *phrenology*. The phrenologists believed that personality could be described as if composed of separate faculties, such as firmness, sublimity, and amativeness, each of which resided in its own area in the brain. If a faculty were highly developed, they believed that the related brain area would be enlarged, and have a corresponding bump on the skull. These pseudoscientists did a flourishing business in the nineteenth century, serving as vocational counselors and fortune-tellers simply by locating and measuring bumps on the head.

Unfortunately for the commercial phrenologists, scientific studies of the brain indicated that the bumps on the skull had nothing to do with the development of the brain underneath. In addition, although research on the brain confirmed the phrenologists' general notion that different areas of the brain performed different functions, it disproved their specific ideas of the localization of personality traits. Figure 16.1 superimposes the phrenologist's map of the brain on some of the functional areas of the brain as we know them today.

Graphology. Another short-cut system of character analysis is the attempt to associate personality traits with handwriting

characteristics. Figure 16.2 represents some of the simpler correlations proposed by graphologists. Bashfulness is supposed to be expressed by fine lines or narrow letters, force by heavy lines. Letters sloping upwards indicate ambition or pride. Crossing *t*'s with long lines is said to be a sign of perseverance, while the careful closing of letters like *a* and *o* is supposed to show reserve.

The correlation coefficients given in parentheses in Figure 16.2 represent the results of a study designed to test these relations. Fraternity brothers rated each other on the traits supposedly indicated by the handwriting characteristics. Of the eight correlations obtained, only two were significant. Narrowness of letters was correlated positively with bashfulness, as predicted by graphology, but fineness of lines was negatively correlated with bashfulness, contrary to prediction. Other studies have found a number of low but significant correlations between handwriting characteristics and rated personality.[2]

Unlike astrology and phrenology, graphology is based on the reasonable assumption that personality is expressed in a person's overt behavior. It may be that with improved techniques of measuring handwriting, graphology will prove useful as one tool among many that are needed to analyze personality.

Constitutional Types. The notion is popularly held that personality traits can be judged by external appearance. Thus novelists speak of the thin-lipped miser, the beetling brows of the gangster, or the red hair of the hot-tempered young man. Although no relationship has ever been found between personality and hair color or facial characteristics, there have been scientists who have believed that distinct personality traits can be related to overall characteristics of body build. Since some of these ideas are rather widely accepted, we should examine the principal theories of constitutional types.

Ernst Kretschmer, a German psychiatrist, formulated a body-type theory of personality on differences which he observed in his patients. He thought that patients suffering from the two major forms of breakdown, schizophrenia and manic-depressive psychosis (which we shall discuss in Chap. 17), showed distinctive characteristics in body build. He described schizophrenic patients as tall and thin—the *asthenic* type—and manic-depressive patients as short and fat—the *pyknic* type. Having set up this system, he tried to show that normal individuals can be classified according to their similarities to one or another kind of psychotic behavior pattern, and that their body build correlates with their personality type. Those people corresponding to manic-depressives (cycloid) are described as friendly, lively, and practical, and *usually* the short-fat type. Those corresponding to schizophrenics (schizoid) are shy, sensitive, and aloof, and *usually* tall and thin.

Kretschmer's theory shows some of the general weaknesses of type-theories of personality. Having proposed originally the two-type theory, he was faced with the problem of accounting for all the people who are neither tall and thin, nor short and fat. Consequently he added a third type, the *athletic*, to include well-proportioned individuals, and a fourth type, *dysplastic*, to include those with some marked abnormality of physical development. The latter two types were not considered to be as specifically related to

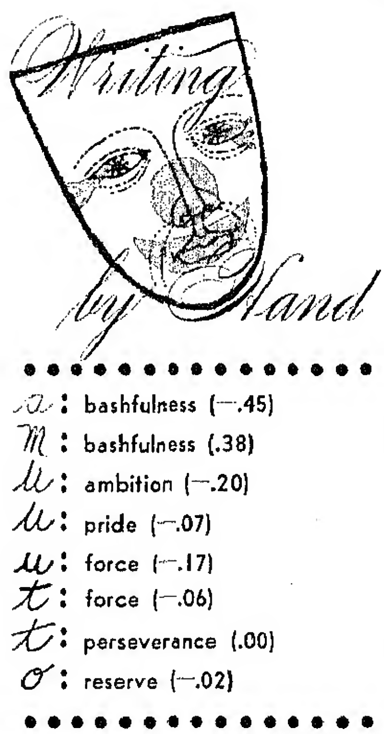


Figure 16.2. The analysis of handwriting. Graphologists try to analyze character or personality by means of handwriting characteristics. The correlations given in parentheses show that personality traits as indicated by graphological analysis do not correspond with ratings made by friends. (From Hull, C. L., and Montgomery, R. B. An experimental investigation of certain alleged relations between character and handwriting. *Psychol. Rev.*, 1919, **26**, 63-75.)

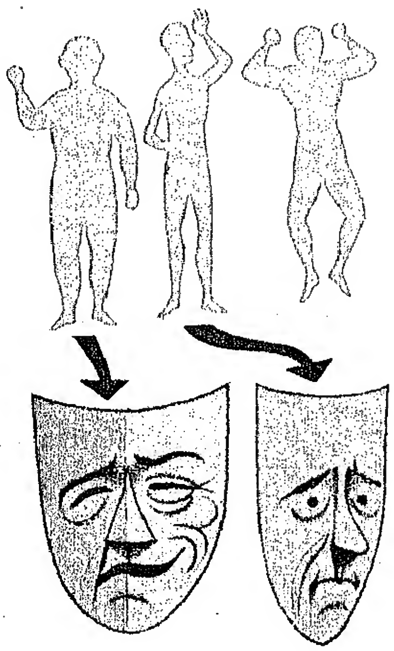


Figure 16.3. Kretschmer's constitutional types. Kretschmer's three principal body types were described as pyknic, asthenic, and athletic. He found a limited correspondence between the first two types and manic-depressive and schizophrenic patients. (Kretschmer, E. *Physique and character.* New York: Harcourt, 1925.)

personality as the first two, but Kretschmer thought schizoid temperament, not cycloid, was more likely to be found in athletic and dysplastic persons. Thus Kretschmer's description of personality remained essentially a two-type theory, as illustrated in Figure 16.3. Although he was able to show limited correspondence between cycloid behavior and pyknic body build, and between schizoid behavior and asthenic body build, his types were not useful in describing the bulk of the normal population. The setting up and labeling of distinct types tends to emphasize extremes and to overlook the fact that most people are very much in between.

A more recent attempt to correlate personality with physique has been carried out by Sheldon and his associates, who base their classification on what they call three components of body build: *endomorphy, mesomorphy,* and *ectomorphy.* As shown in Figure 16.4, these three components refer in general to fatness, muscularity, and linearity in body build. Any individual can be rated according to the relative amount of each component he exhibits, on a scale ranging from 1 to 7. Thus an extreme endomorph would be rated 7–1–1, an extreme mesomorph, 1–7–1, and an extreme ectomorph, 1–1–7. Most people fall somewhere in between with ratings like 5–3–3, or 4–5–2. This system of rating, or "somatotyping," is derived from a set of seventeen body measurements taken from standard photographs.

Sheldon has related his somatotypes to a threefold classification of personality. He constructed a temperament scale by means of which a person can be identified with three basic personality types: *viscerotonic*—comfort-loving, slow to react; *somatotonic* — adventurous, withstanding pain easily; and *cerebrotonic*—asocial, nonadventurous. These descriptions are also made on a three-dimensional seven-point scale. Sheldon found a high degree of relationship between endomorphy and viscerotonia, between mesomorphy and somatotonia, and between ectomorphy and cerebrotonia, as shown by the masks in Figure 16.4. These high correlations are not unexpected, in view of the fact that the rating scale was tailored to fit the three-type theory. Traits which did not reflect these dimensions were excluded. Thus many significant aspects of behavior and personality might well be overlooked in such a type-system. Furthermore, Sheldon's system of classification does not necessarily isolate the critical variables in personality which would enable one to predict behavior and adjustment.

Several studies indicate that there are few, if any, significant correlations between the somatotypes and other personality measures. An analysis of over 500 items in one well known personality test indicated that none of the items could differentiate reliably between groups of men with distinctly different somatotype ratings.[3] Another study found no significant correlations between somatotype ratings of 176 adolescent boys and measures of intelligence, personality characteristics, motor abilities, and physiological processes.[4] While it is true that relationships are sometimes found between body build and personality traits, these relationships are too small to be of value in predicting behavior from measures of physique. There may be physiological variables, such as the hormonal balance in the body,

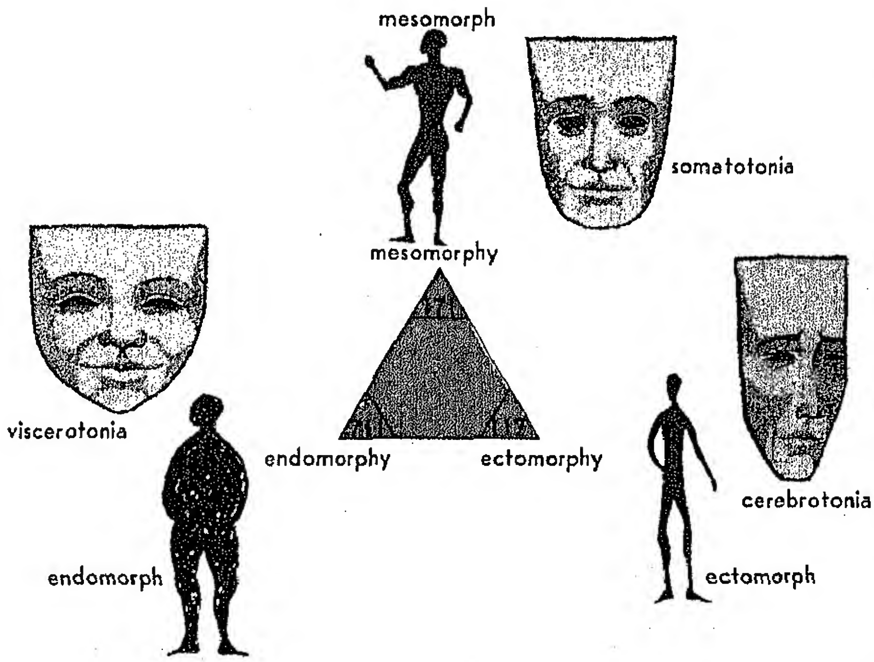
which influence both body build and personality development, but no definitive relationships have been established.

Weaknesses in Systems of Personology. The theories which we have reviewed in this section have failed to contribute materially to scientific psychology because of some basic weaknesses in their approach. Perhaps the most serious inadequacy is in setting up a tight system of personality classification based as much on oversimplified analogies as on carefully controlled observations. The systems have tended to dominate the observations, rather than the other way around. All of these theories, from Hippocrates to Sheldon, are based to a greater or lesser degree on factual observations, but in each case the main interest has been in describing people to fit the system, rather than in modifying the system as objectively established facts seem to warrant.

Another weakness in personology is that no one system can encompass all the factors we usually associate with personality. Personality is not a *thing*. It cannot be isolated by somatotyping a man or analyzing his handwriting. Slowly and with much effort we are beginning to appreciate that personality is not even contained within the individual, but is a composite expression of the complementary interactions between the person and his social world. Like all of man's complex behavior, personality cannot be traced to simple causes, but develops as the result of many interacting factors. As behavior is modified in the life pattern, personality also changes, in relation to biological needs, emotional reactions, social roles, and the bodily changes in injury, disease, or old age. Personality reflects the progressive course of the individual's psychological development in his critical life roles.

The main effort today in the scientific study of personality is to describe and measure some of its characteristics, and validate their usefulness in predicting and controlling behavior. To this end many methods are used and many tests have been devised. None of these methods or tests gives a complete or an infallible description of human personality, but each contributes to a broader understanding of a difficult field. Some of the methods of measuring and assessing personality which we are going to examine in the following pages are the objectively scored tests known as personality inventories, projective tests, and various kinds of interviews.

Figure 16.4. Sheldon's system of somatotypes. This system classifies persons in terms of three components of body build and relates these physical characteristics to three aspects of temperament. (Sheldon, W. H., Stevens, S. S., and Tucker, W. B. *The varieties of human physique.* New York: Harper, 1940; Sheldon, W. H., and Stevens, S. S. *The varieties of temperament.* New York: Harper, 1942.)



SELF-INVENTORIES

The design and standardization of objectively scored inventories of personality characteristics has been an active field of research within psychology since Woodworth designed his "Personal Data Sheet" during World War I. This questionnaire was devised to tell whether draftees were well adjusted or psychoneurotic. Since this first personality inventory, there have been innumerable attempts to measure personality by questionnaires and rating scales. Some of these tests have gone no further than the Sunday supplements, but others represent years of careful standardization and research by well-trained scientists.

Personality tests are often called inventories because their questions are not answered on the basis of factual knowledge or skill, but must be answered in terms of personal opinion, belief, or attitude. Although the content of such a test deals with personal opinions, the scoring is made objective by comparing answers with responses made by many other persons. The intent in designing an inventory is to obtain a series of responses from the individual which will disclose personality characteristics not otherwise apparent, either to the individual or to others.

The Nature of Personality Inventories. The items commonly found in personality inventories range from true-false and multiple-choice questions similar to those used in objective examinations, to items that ask for likes and dislikes, preferences, and degree of certainty. Items similar to those listed below have been found useful in assessing personality characteristics.

Yes-No items:

1. Do you express yourself more easily in speech than in writing?
2. Are you ordinarily a carefree individual?

True-False items:

1. I have a great deal of stomach trouble.
2. Someone has it in for me.

Like-Dislike items, to be checked Like, Dislike, or Indifferent:

1. People with gold teeth.
2. People who get rattled easily.

Multiple-choice items:

1. Feelings easily hurt ( ); feelings hurt sometimes ( ); feelings rarely hurt ( ).
2. Tell jokes well ( ); seldom tell jokes ( ); practically never tell jokes ( ).

Preference items, choose A or B:

1. A. I like to be loyal to my friends.
   B. I like to do my very best in whatever I undertake.
2. A. I like to tell amusing stories and jokes at parties.
   B. I like to write letters to my friends.

Certainty items, mark C (certain), F (fairly certain), S (somewhat certain), or D (doubtful) for the statement in each pair which best expresses your situation:

1.	Definite plans for the future.	C F S D 8 7 6 5
	No plans for the future.	C F S D 1 2 3 4
2.	Frequently misunderstood by people.	C F S D 8 7 6 5
	Usually understood by people.	C F S D 1 2 3 4

The use of yes-no and true-false items in personality tests is limited because

some individuals feel that they are being forced to respond to questions of opinions as if they were facts. As a substitute, the like-dislike or preference items can be used. The multiple-choice and certainty items permit a wider choice of alternatives. In addition, the response to a certainty item can be expressed quantitatively. The individual chooses from a pair of statements representing opposite viewpoints the one which more closely describes his attitude, and then expresses his feeling of certainty about his choice by marking C (certain), F (fairly certain), S (somewhat certain), or D (doubtful). As indicated by the numbers given below these letters, which would not actually appear on the test, the certainty choice can be given a numerical weight on an eight-point scale.

One weakness in the use of personality questionnaires is that a person can deliberately falsify his responses. Many of the items are fairly obvious in intent, and an intelligent person can influence his score by faking his answers. One method of controlling this tendency is to word the response choices in such a way that the respondent cannot tell which choice would create the best impression. The preference or forced-choice item is often used for this purpose. In the preference examples given above, the two response alternatives are unrelated and represent equally acceptable attitudes, so that the respondent is forced to make his choice in terms of personal preference.

The most difficult task in designing personality inventories is the actual selection of items which will reflect meaningful dimensions of personality. Sometimes items are selected because truthful answers to them are obvious indications of the characteristic being measured. For example, the Taylor Manifest Anxiety Scale[5] contains a series of yes-no items related to worry and overemotionality. If statements like "I worry a great deal," or "I bite my nails" are marked true, and statements like "I fall asleep easily at night," or "I am usually calm during an examination" are marked false, such replies are obvious indications of anxiety. Such items have "face validity"; that is, the content of the item itself suggests a personality characteristic.

Items also may be selected through factor analysis, as they were for the Guilford-Martin Inventory. Five groups of items which correlated highly with one another and showed little relationship with items in other groups were inspected to determine what characteristic each had in common. The groups of items were then named according to their common characteristic, such as sociability or depression. Items selected in this manner also are said to have face validity.

The selection of items on the basis of face validity has two main disadvantages. First, since the content of the item indicates the personality factor being measured, the respondent can easily fake his answer. In addition, there is no assurance that items which appear to reveal characteristics like anxiety or depression actually do measure these characteristics. Just as the correct answer to a simple arithmetic problem does not differentiate between people of average and superior intelligence, the response, "I am not afraid of the dark," may not differentiate between anxious and nonanxious people. To avoid the disadvantages of face validity, items can be selected by the *item analysis* method. This technique consists of com-

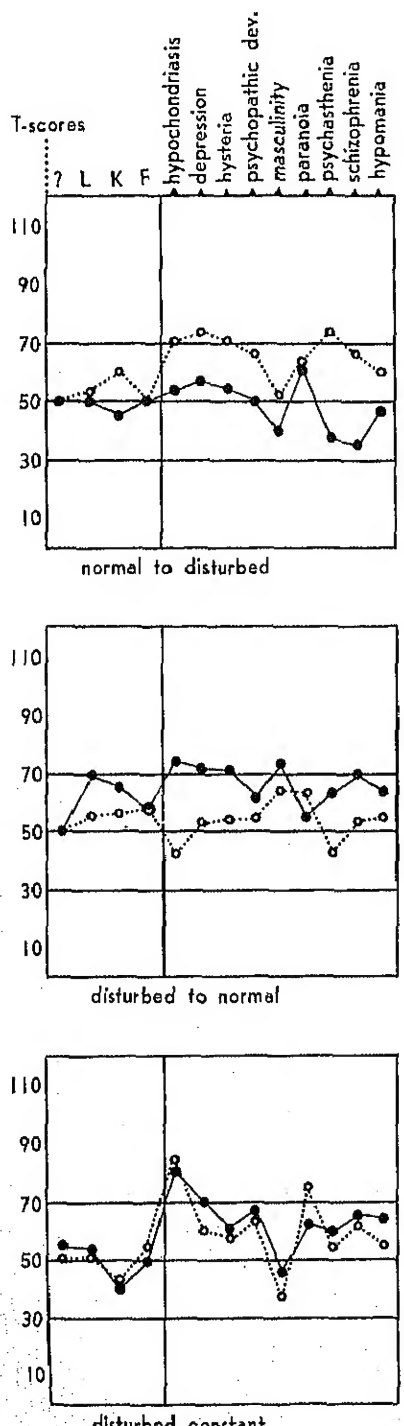


Figure 16.5. Effects of changed environment on MMPI profiles. Prisoners tested on admission to prison (solid lines) and again several months later (dotted lines) in some cases showed changes from normal to disturbed profiles or from disturbed to normal, but in other cases showed no significant changes. (Data from C. Gallenbeck.)

paring responses from two groups of persons who differ on some known personality characteristic and selecting those items which are answered differently by the two groups. When this method is used to select items, the items themselves need not be obvious in content so that the respondent knows how he "ought" to answer. The only requirement is that the items actually differentiate between groups of persons known to be different in a personality characteristic.

Minnesota Multiphasic Personality Inventory. The item analysis method was used in constructing the Minnesota Multiphasic Personality Inventory, commonly called the MMPI. Five hundred and fifty true-false items were given to a group of normal people and to nine groups of mental hospital patients. Each hospital group was characterized by a different pattern of abnormal behavior. Those items which were answered differently by the normal group and one of the abnormal groups were selected to construct nine scales to measure personality in terms of the similarity of responses to those of mental patients. The nine scales are named according to the abnormal groups used in selecting items for each scale, as follows:

1. *Hypochondriasis* — unreasonably concerned over physical health.
2. *Depression* — emotionally depressed.
3. *Hysteria* — emotionally immature with emotionally based physical symptoms.
4. *Psychopathic deviation*—rebellious and antisocial.
5. *Masculinity-femininity* — feminine interests in men or masculine interests in women.
6. *Paranoia*—believing illogically in persecution.
7. *Psychasthenia*—obsessive and compulsive.
8. *Schizophrenia* — withdrawn from external reality.
9. *Hypomania*—markedly enthusiastic and overactive.

The MMPI can be administered in booklet form, in which the individual marks an answer sheet, or as a card-sorting task. In the latter case each test item is in the form of a statement on a card, and the person sorts the cards into compartments labeled "True," "False," and "Cannot Say." These responses are then transferred to an answer sheet and scored separately for each of the nine scales by using overlay stencils, punched to show the responses that contribute to each scale. The nine scores are expressed as T-scores on a profile, such as those shown in Figure 16.5, which we shall discuss later. The horizontal line across the profile at 50 indicates the mean scores of the normal individuals on whom the test was standardized, while the line at 70 indicates the nine mean scores for each of the nine groups of patients.

Validity scales in the MMPI. As we mentioned above, personality inventories are usually susceptible to deliberate or nondeliberate faking or lying on the part of the individual taking the test. Although the items in the MMPI are susceptible to

faking, there are several special scales which have been constructed to detect it. These "validity" scales are shown at the left of the profiles in Figure 16.5. In general, a high score on any of these scales is a warning that the test results are not accurate. The question (?) scale simply indicates the number of items to which the person responds "Cannot Say." A high number in this category limits the usefulness of the test.

The F scale was originally designed by selecting items in all of the nine personality scales which were almost always answered in the same way by the standardization groups.[6] In a group of 64 such items, if 12 to 16 answers differ from the usual trend, the corresponding F-score is believed to indicate an invalid record because of excessive self-criticism, very unusual attitudes, or misunderstanding of how to take the test. The L scale was designed in much the same way, by selecting items presenting situations which are desirable socially but rarely true of the individual. A high L-score, then, is indicative of deliberate lying to better one's score.

The F and L scores are useful in detecting extreme distortion, but are not always effective in spotting more subtle falsifications or defensive attitudes which may distort the record. To meet this need, a K scale was devised to help discriminate between normal and abnormal individuals. It was standardized on individuals in mental hospitals whose MMPI profiles were normal, although these people were known to be abnormal. Items were selected which differentiated between these patients, who were believed to have defensive attitudes which held down their profiles, and normal people. A high K-score is interpreted as indicating defensive attitudes, while a low K-score suggests unusual frankness and self-criticism.[7]

Reliability of MMPI profiles. In general, personality tests are not as reliable as intelligence tests, although the MMPI compares favorably with intelligence tests in this respect. Normal individuals who take the MMPI more than once usually show no marked changes.

However, it has been shown that drastic changes in the environment can produce shifts in MMPI scores. The profiles in Figure 16.5 were selected from the scores of a group of prisoners who were tested when they first entered prison and retested four to six months later. The first pair of profiles are from a man who had a fairly normal profile when he entered prison but who showed marked deviations after several months there. The second pair shows just the opposite effect. A man who appeared abnormal when he entered prison had quite a normal profile five months later. The last pair of profiles shows an abnormal behavior pattern that was consistently maintained. Variations in MMPI profiles can also be shown in psychiatric patients who are undergoing treatment. We must conclude that, while we expect fairly stable profiles in normal individuals living in an ordinary environment, drastic changes can and do occur under unusual conditions.

Although there are many carefully constructed personality inventories, of them all the MMPI has been subjected to the most rigorous research procedures, with respect to its construction, its standardization, and its applications. This inventory represents personality testing at its best, and for that reason we have described it at some length. After surveying some of

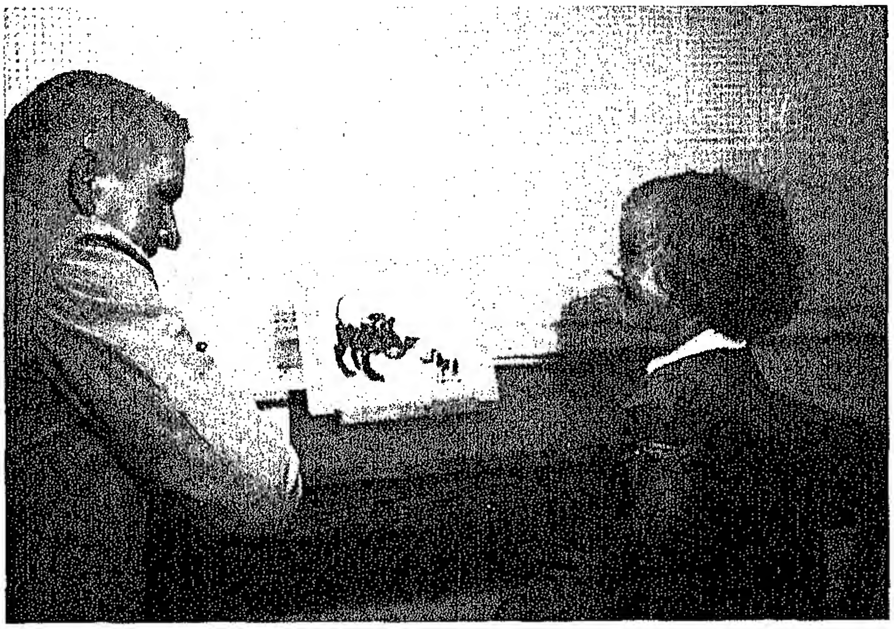


Figure 16.6. Analyzing personality by means of Blacky Pictures. A projective test oriented toward psychoanalytic theory, Blacky Pictures are based on the psychosexual problems of a black puppy. (By permission of the Psychological Corp.)

the other methods of personality assessment, we shall attempt to evaluate the general usefulness and validity of the MMPI and other types of tests.

PROJECTIVE TESTS

The objectively scored personality inventories are widely used in educational, industrial, and government testing programs, as well as in psychological clinics which deal primarily with individual problems of adjustment. One great advantage of these tests is that they can be given to groups of people simultaneously, and do not need highly trained psychologists either to administer or to score them. Many psychologists feel, however, that inventories are not adequate for understanding the personality of troubled individuals. They stress the importance of what we call the global assessment of personality organization in relation to the problems of the individual. An important tool for this purpose is the *projective test.*

A projective test is a perceptual or verbal situation which the individual interprets freely according to his own attitudes and fantasies. According to the "projective hypothesis," a person expresses his own view of the world, his fears, desires, attitudes—in short, his personality—in his every action. We recognize that creative artists, for example, leave the stamp of their own personality on their work through their choice of subject and its interpretation in colors, forms, words, or actions. In somewhat the same way, projective tests provide clues to personality organization by permitting free interpretation, imagination, and creative thought in the controlled test situation. Some psychologists believe that projective tests reveal deeper and more meaningful dimensions of personality than those measured by inventories.[8] The latter require honest answers to the questions and a certain amount of insight into one's own behavior. In contrast, telling a story or describing a picture may reveal hidden, private attitudes which the person would not admit even to himself.

Blacky Pictures. A recently developed projective technique is based on a set of twelve cartoon drawings called the *Blacky Pictures* (Fig. 16.6). Blacky is a black puppy who is beset by all the psychosexual problems which Freud thought were the basis of human personality difficulties. According to Freudian theory, there are several stages in normal psychosexual development, beginning with oral gratification from the mother and ending

with normal heterosexual adjustment. Each stage of this development, with its own set of problems and anxieties, is represented in the drawings. The person taking the test is asked to tell a story about Blacky's reactions to each psychosexual situation. In addition, he is asked a series of direct questions about each drawing, and at the end of the test chooses his favorite drawing. The assumption is that human subjects taking the test identify themselves with Blacky and react to his dog-world as they would react to similar situations in the world of people.[9] Dogs are used in the drawings because presumably people can talk about the sex life of a dog with less embarrassment and inhibition than they can about their own.

Since this test is fairly recent, only a small amount of research is available to indicate its advantages and limitations. At present, it appears that predictions from the test agree quite closely with predictions made on the basis of psychoanalytic theory. For psychoanalysts this test may be a useful tool.

The Rorschach Test. In 1921, a Swiss psychiatrist named Hermann Rorschach first described a series of ten ink blots which could be used to gain insight into an individual's personality. Since that time, the use of the Rorschach Test has spread throughout Europe and the United States, new methods of scoring, administration, and interpretation have been devised, and it has been the subject of many books and research papers. The ink blots shown in Figure 16.7 resemble some of the original Rorschach cards.

The person taking the test is asked to tell the examiner what the ink blots look like to him. He is encouraged to describe everything he "sees." The examiner records the descriptions verbatim and later scores them according to several categories: *location*—whether responses are based on the whole blot, details, or white spaces; *determinants*—whether responses are organized in terms of form, "movement," shading, or color in the blot; *content*—whether blots are interpreted as an animal, human figure, a part of a map, a scene, and so forth; and *popularity* or *originality* of the content. A large number of popular or common responses is supposed to indicate conformity with social thinking. The interpretation of responses to the Rorschach test requires special training. The scores for location, form, color, and so on are not considered separately but must be drawn together to form a picture of how the personality is organized. Examiners are guided in this task by a set of general rules, but since these rules cannot be made completely objective, the final interpretation always depends upon the training, theoretical viewpoint, and experience of the examiner.

In the hands of a skillful examiner, the analysis of a Rorschach record can provide a broad picture of the personality of the subject. Intelligence level, characteristic emotional reactions, motivations and aspirations, social needs and skills, sexual desires and inhibitions, and typical thought processes are some of the areas covered by a Rorschach interpretation. In addition, these aspects of personality are interrelated to indicate areas of adjustment and conflict, showing the balance between characteristics which determines the individual's reactions. A man with strong sexual desires may inhibit them because he is socially shy or

Figure 16.7. Analyzing personality by means of ink blots. These ink blots are similar to some of the blots in the Rorschach test, a projective test widely used to assess personality. The subject describes in detail all that he "sees" in the blots.

insecure. A woman of high intelligence may ignore her emotional reactions and try to solve all problems by logical reasoning. A man may feel strong hostility toward his wife, but still be in great need of her love. Rorschach interpretation is an attempt to understand the compromises between wish and reality, between desire and fear, between intellect and emotion which are part of what we call personality.

Thematic Apperception Test. In the Thematic Apperception Test, or TAT, the individual is asked to tell a story about each of a series of pictures. Figure 16.8 shows a child taking the children's form of this test, the CAT. The pictures suggest some of the characters and the setting for a story, but the plot, the feelings of the characters, and the outcome of the story are dependent on each person's interpretation of the picture. It is assumed that the respondent identifies himself with one of the characters of his story and that the motives and aspirations attributed to this character are really his own. The examiner, analyzing the story, looks for the themes or ideas expressed in it. Themes which appear again and again are assumed to be particularly important to the individual and indicative of his own problems and needs.

Figure 16.8. The Children's Apperception Test. The CAT and the TAT for adults are used to assess personality by having the respondents tell stories about a series of pictures. (By permission of the CPS Co.)

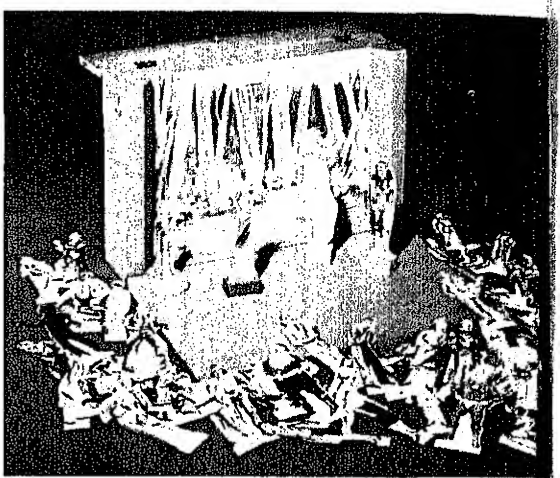


Figure 16.9. The MAPS test. The person taking the test chooses a scenic background and then creates a story by selecting characters and placing them on the stage. The scoring procedures are more standardized than with some projective tests. (Courtesy the Psychological Corp.)

Picture Arrangement Tests. One major difficulty with tests like the Rorschach and the TAT is that since no two persons respond alike to ink blots or pictures, it is difficult to develop objective methods of scoring and interpretation. Although many people tell similar TAT stories or see similar figures on the Rorschach

cards, at present there are no generally accepted response norms for either of these tests. Projective tests which do lend themselves to more standardized scoring are the Make-a-Picture-Story Test (MAPS) and the Picture Arrangement Test (PAT).

As shown in Figure 16.9, the MAPS test consist of a stagelike presentation screen, into which any one of a number of scenic backgrounds can be inserted. The individual uses some 67 cardboard patterns of people, in various postures, states of dress, and so on, in order to create a story suitable to the background. In the picture shown, a ghost, a beastlike person, a girl, and a boy are arranged in a picture story before a wooded background. The story is interpreted in terms of its meaningfulness, unusualness, and nature of the characters selected.

The PAT is distinctive as a projective test because it has been nationally standardized on 1500 people, a sample obtained systematically with the aid of an agency which conducts national public opinion surveys.[10] Each item in the PAT contains three pictures, identified by a triangle, a rectangle, and a circle, which the subject arranges into the order which seems to him to tell the most meaningful story. Underneath the pictures are three lines on which the subject draws the identifying marks in the chosen order and writes a sentence beside each one. Figure 16.10 shows two sets of pictures which indicate the type of situation used. In the first set the marks have been arranged in the order of rectangle, circle, triangle. The descriptive sentences accompanying these marks might be: "A man and his wife passed each other while working at home," "They stopped to talk a minute," and "The wife said something which made the man want to hug her."

The significant contribution of the PAT to the field of projective testing is that it combines the advantages of objective scoring and standardization techniques with the freedom of interpretation associated with projective tests. The standardization research has investigated the ways in which many social variables affect the responses to the test. Because groups of differing age, intelligence, and education respond differently, scoring procedures are used which take these factors into consideration. On the other hand, variables such as sex, marital status, religion, occupation, race, class, residence locality, and geographical area do not have a marked effect on the responses.[11]

Results with this test have been checked over a period of thirteen years with normal groups and with individuals defined as neurotics and psychotics. The research has shown that the PAT gives information similar to that obtained by other projective tests but is more objectively scored. When analyzed in terms of distortion of the events in the pictures, especially by denial of the existence of certain events, scores have been found to discriminate significantly between different psychotic groups and a normal group.

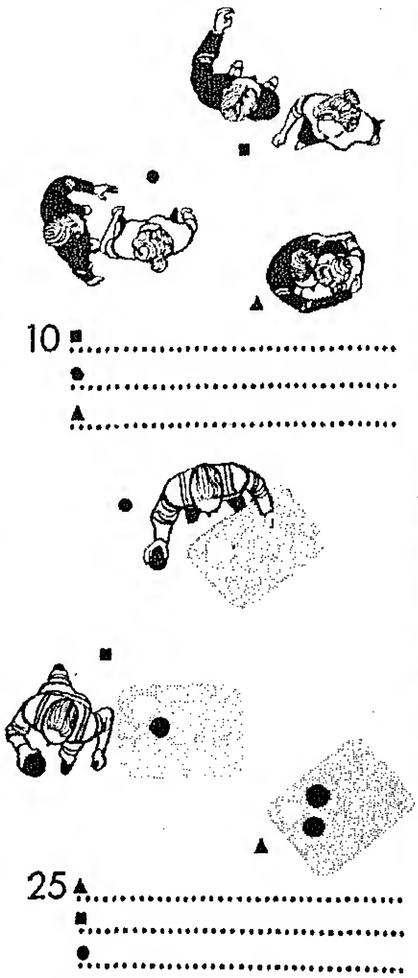


Figure 16.10. A picture arrangement test. These picture stories are similar to items in the PAT. Three pictures, each identified by a symbol, are arranged in a sequence to tell a story. The PAT is scored more objectively than other projective tests.

INTERVIEW ASSESSMENT

Before the era of psychological tests, the method used to assess the personality of another person was by personal observation. This is still the most widely used method. By observing the actions of others, and by talking with them, we form our opinions of their personalities. When this give-and-take is formalized to

serve some specific purpose, we call it the personal interview. The interview method is used by doctors, lawyers, counselors, poll takers, personnel officers, teachers, and many more to gather information, both specific and general, about the lives and behavior of other people.

The Patterned Interview. Interviewing can proceed in several different ways. If the interviewer is interested in collecting specific, factual information, he asks direct questions and gets factual answers. In the patterned interview, the interviewer asks more general questions and the subject is free to answer at length. By this method, general topics such as interests, education, and work experiences can be explored, and the interviewer forms an opinion of personality by evaluating the attitudes expressed.

A patterned interview follows a standardized list of questions covering several common channels of adjustment. If it is used for the selection of executives, salesmen, or professional people, the areas covered might be childhood background, education, work experience, hobbies and recreation, community activities, and family activities. A typical interview blank contains questions such as the following about the job applicant:

What particularly interests him (in this job)?
What salary does he expect?
What were his duties (in his last job)?
Reasons for leaving?

The interviewer often begins by asking a general question and marks down on the form those specific answers which the subject supplies in the course of his response. If the subject does not answer all the questions spontaneously, the interviewer interjects further questions to elicit the necessary information. Thus the interviewer can gather much specific information, although he allows the individual considerable freedom of discussion. Many questions of an apparently factual nature are asked not because the facts themselves are important but because the interviewer can make certain judgments of the applicant from his answers. Thus in asking "What were his duties?" the real interest is not so much in actual duties as in habits of accepting responsibility.

The Nondirective Interview. A technique which minimizes the probing by the interviewer is known as the nondirective interview. Rather than asking direct questions, the interviewer attempts to reflect the feelings of the client in such a way that the client will talk freely about himself, his problems, his hopes, and so on. Nondirective methods are widely used to interview people with emotional, personal, or vocational problems. In such cases, the purpose of the interview is not to collect information important to others, but to find out what the person himself considers important. According to Rogers, a leader in the use and development of nondirective interviewing or client-centered therapy, it is based on the premise that the individual has the capacity to understand himself and to solve his own problems if he can accept fully his own feelings without fear, shame, or guilt.[12] It is the interviewer's task to help the individual accept himself by respecting the client as a person and by considering his thoughts and feelings as significant and important.

The aim of the nondirective interviewer is to understand the subject not from the

"outside looking in" but to see him as the subject sees himself. Several communication skills, both verbal and nonverbal, are needed to achieve this end. The interviewer's facial expressions, gestures, movements, and postures must express his respect for his client, and above all, they must convey his full sympathetic acceptance of all statements, no matter how shocking or fearful they seem to the client. Instead of questioning the client, he acquires the ability to sum up in a few sentences the feelings which the client expresses. He verbally reflects the emotions of the client, but does not share the client's feelings of guilt or anxiety about them. This reflection and clarification of his ideas and feelings helps the client understand his confused emotions and often allows him to state new ideas based on a better understanding of himself. Strictly speaking, nondirective interviewing is not used for personality diagnosis except as the client diagnoses himself in the process of treatment. However, many of the attitudes and verbal skills used by nondirective therapists have been used by interviewers interested in personality assessment, because they promote friendliness of conversation and a thorough discussion of personal problems.

The Psychoanalytic Interview. Psychoanalysis, like nondirective therapy, is a specialized method used to help people with personal and emotional problems. However, as the word psychoanalysis implies, an important part of the process of therapy is the interviewer's analysis of both the person and the problem. The psychoanalytic interview differs from other forms of interview assessment chiefly in the nature of the verbal communication. In addition to describing his present problems in ordinary terms, the subject or patient is asked to relax on a couch and "free-associate"—that is, recount anything and everything of which he is aware. He describes all the nonsensical phrases, foolish ideas, meaningless thoughts, and dream memories which occur to him. He is encouraged to report his dreams in the greatest possible detail. From this raw material, the psychoanalyst attempts to understand the patient's personality, and makes an interpretation of the origin, the nature, and the effects of his internal conflicts. Recognition of the sources of a conflict gives a person the means of facing his trouble and of dealing with it. The psychoanalytic interpretation of conflict is based on an elaborate theory of personality, which we shall discuss later.

EVALUATING PERSONALITY ASSESSMENT

The general value of the various methods of personality assessment is one of the most controversial subjects in psychology today. Devotees of various inventories claim that these techniques are superior to interviews and projective tests because they have well-defined scoring standards and provide standardized norms for interpretation. In contrast, advocates of projective tests insist that scores on quantitative scales of personality characteristics are superficial and cannot provide meaningful information about the total integration and balance of an individual's personality. A third opinion expressed by many interviewers is that neither inventories nor projective tests can tell them what they want to know about a man's personality. They are con-

vinced that while tests may be helpful, the face-to-face contact of the interview is the most important factor in personality assessment.

One reason for such a wide diversity of opinion is that the scientific measurement of personality is still in its infancy, and each technique has definite limitations. Almost all personality measures lack adequate standardization. This is particularly true of the interview and projective techniques, with the exception of the PAT. Inventories generally have been standardized on small populations, which do not provide a good basis for national norms. College students, for example, do not make the same average scores on the MMPI as do the "normal" people in the standardization group.

In discussing the reliability of personality inventories, we pointed out that test scores may vary with changed circumstances. In spite of such variation, the test-retest correlations of scales on multiple batteries like the MMPI are around +.75. The general reliability of projective tests and interviews, on the other hand, is not known. Although one examiner may score Rorschach or interview records quite consistently, another examiner might not agree with him. Since it is extremely difficult to standardize people's personal judgments, the reliability of interview and projective techniques can be increased most effectively by making scoring standards more objective.

The lack of adequate standardization and reliability in personality assessment partially accounts for its low validity. However, even measures of low validity may sometimes be useful. When an understanding of personality characteristics is important, as it is in helping people with psychological problems or in selecting people for specialized or dangerous jobs, the knowledge gained from interviews and tests may be better than no knowledge at all.

As we pointed out in Chapter 15, the accuracy with which predictions can be made from tests and other measures depends on the type of prediction made. Individual prediction is typically less accurate than group prediction.

Group Differentiation. Although we think of personality assessment as an individual matter, differentiation among groups of individuals on a personality variable or variables is frequently an important consideration. Thus the MMPI differentiates between normal groups and individuals diagnosed as having various forms of behavior difficulty. Other personality inventories do the same thing with varying degrees of success.

The projective tests can also make significant distinctions between groups. The Blacky Pictures test has been reported to differentiate prison homosexual groups from groups of convicts exhibiting no sexual aberrations. Rorschach and PAT scores have been reported to be effective in distinguishing psychotic groups from groups of average people. However, we have no good quantitative data on the percentage of people in these groups who would be misclassified by projective tests.

Analysis of Personality Organization. In general, personality inventories alone cannot be used to make a "global" evaluation of personality. One of the major claims for the projective test, however, is that it can establish an overall diagnosis or analysis of personality. This

analysis rests not only on the test but also on theories of personality, largely psychoanalytic, which cannot at present be proved or disproved. If the theory does not adequately explain the nature of personality, the interpretations of projective tests cannot be accepted as valid indicators of personality organization. Probably the best evidence for the validity of such tests in global evaluation is their widespread acceptance and use by clinical psychologists and psychiatrists. However, one should never accept a personality test score or interview interpretation as a single decisive indicator of a person's total adjustment pattern.

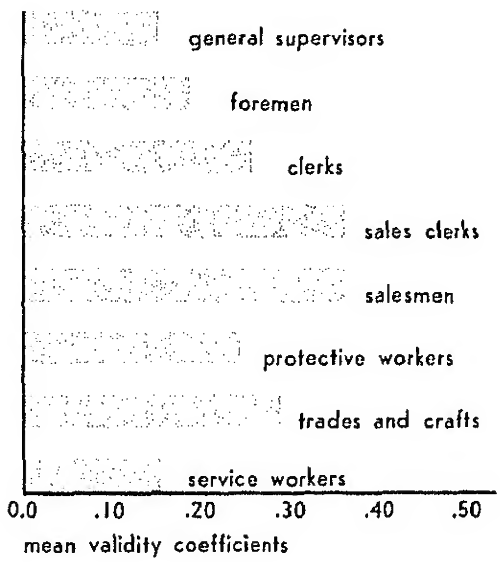


Figure 16.11. The validity of personality inventories in predicting job success. Personality tests have shown disappointingly low validities when used to select employees. (Based on Ghiselli, E. E. and Barthol, R. P. The validity of personality inventories in the selection of employees. *J. appl. Psychol.*, 1953, 37, 18-20.)

Predicting Adjustment. We know that many factors—personality variables as well as specific skills—enter into satisfactory adjustment at home, at work, and with our friends. Personality tests are often used to predict future adjustment, either of single individuals or of groups of people. Figure 16.11 summarizes the results of 113 studies of the use of personality inventories in individual prediction of job success. Each bar in the graph represents the weighted mean validity coefficient for an occupational group. Some of the results of these studies clearly are contrary to popular notions. We see that personality tests are of little value in predicting the success of supervisors or foremen, but are somewhat more efficient in predicting the performance of clerical workers. The best overall results were obtained with salesclerks and salesmen. The weighted mean correlation of +.36 for these groups indicate that certain personality factors are important for successful salesmanship. Otherwise the correlations show that personality inventories are not very good predictors of job success.

These disappointing results have led people to ask if other methods of personality assessment might be more effective. In an effort to answer this question, several different measures of personality were compared for their effectiveness, used singly and in various combinations, in predicting success in the practice of clinical psychology. A group of students just beginning graduate training under the Veterans' Administration program for clinical psychology were given a series of tests and interviews. After they had been in training for two years, the results of these personality measures were correlated with eight different criteria of successful work in the field, including (1) skill in clinical diagnosis, (2) skill in individual therapy, (3) ability in research, and (4) job promise in becoming a successful clinical psychologist. The students were evaluated by both their university

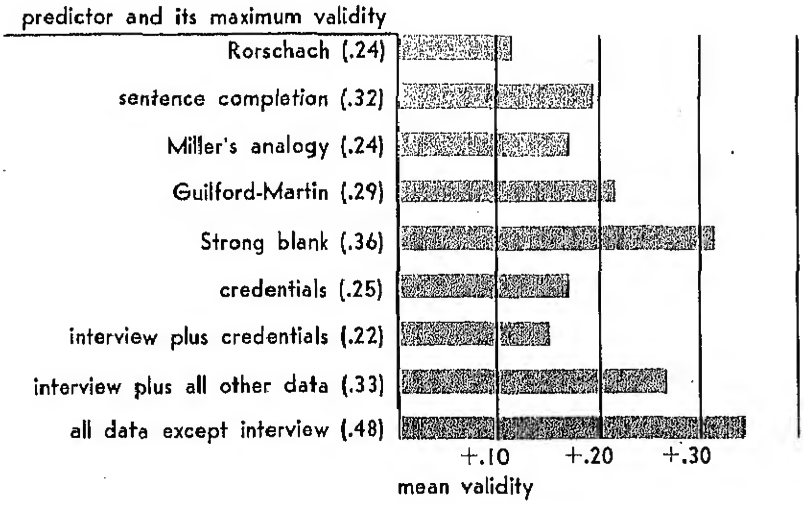


Figure 16.12. Prediction of success in clinical psychology. Different methods of personality assessment were used singly and in combinations to predict success of VA students entering training in clinical psychology. In general, predictions based on objective data were more valid than those based on interviews or projective tests. (Based on Kelly, E. L., and Fiske, D. W. The prediction of success in the VA training program in clinical psychology. *Amer. Psychol.*, 1950, 5, 395-406.)

teachers and their VA installation supervisors.

The main results of this study are summarized in Figure 16.12, where the bar graph shows the mean validities of different test, rating, and interview procedures in predicting various criteria of success. The coefficients given in parentheses beside each predictor represent the maximum validity found for any one criterion. The results show that the different predictive measures all had low validity. Objective tests had higher validity than projective tests. Interviewers were asked to predict the success of students first on the basis of credentials alone, then make further predictions using credentials plus objective test results, these data plus autobiographical material, all of these data plus projective test interpretations, and, finally, all of these plus the results of an intensive interview. The personal interview added nothing at all to the validity of the predictions—if anything, it decreased the validity. The best predictions were made by using all of the data except the interview, but almost as good predictions were made on the basis of one objective test alone, the Strong Vocational Interest Blank.

Other results also throw doubt on the validity of elaborate interpretative interviewing procedures in the prediction of individual adjustment. In one study of *prediction of successful performance* of policemen, a brief interview technique was compared with a "stress" interview, which consisted of disdainful questioning by trained interviewers of job applicants.[13] Although the validity of the "stress" interview was barely significant, the brief interview proved to be more successful in predicting job performance. Generally speaking, predictions based on objective information are more valid than those based on interpretative interviews.

Group prediction, which does not require the high standards of validity that are necessary for individual prediction, has been somewhat more successful. Validation and cross-validation of the Standardized Diagnostic Interviewer's Guide,[14] built along the lines of a patterned interview, have demonstrated that it could differentiate significantly between those employees who proved to be successful and those who could not retain their jobs. Inventories and projective tests also can be used for screening. The MMPI, for example, has been of value in identifying neurotic and psychotic draftees unfit for military duty.[15]

Since inventories can be given quickly to large groups, they provide an efficient means of screening probable misfits who then can be evaluated more thoroughly by the psychologist or psychiatrist. Interviewing and projective testing are less efficient in screening because they require

individual examination by highly trained personnel. It must be remembered that no matter what screening technique is used, some of the people will be misclassified. Decisions of vital importance to individuals should never be made on the basis of screening alone.

The use of personality-assessment techniques as forecasting devices is naturally limited by the fact that they deal with dimensions of behavior which are interrelated in complex ways and are also subject to change. Moreover, our society has no decisive standards of social and emotional behavior comparable to the standards of intellectual performance. Hence, it is difficult to measure precisely the real-life criterion values attached to personality adjustment. The best we can do at present is to obtain gross measures which will differentiate between normal and emotionally troubled groups of people.

THE ORGANIZATION OF PERSONALITY

All of the efforts to assess and measure personality have been directed toward one end—that of better describing, understanding, and predicting behavior in the individual. Because of the diversity of human behavior, many psychologists have felt the need of a broad theory or model to systematize the wealth of psychological detail. Thus we look for the consistencies in response patterns. When they are alike, we want to know the factor that makes them so; conversely, we want to understand what leads to differences in behavior. The theories of personality are numerous and it is impossible to discuss each of them here. For our purposes we shall group them broadly into three general points of view, each of which we shall summarize briefly.

Trait Theory. One of the earliest theoretical approaches to personality was to view it as made up of specific traits. A trait can be thought of as an inner determining tendency that leads to consistency in behavior, or it can be described in terms of the similarities that actually are observed in overt response. Our inventories and objective tests lend themselves to interpretation in terms of traits (Fig. 16.13). Thus an MMPI score expresses how much an individual deviates from the normal in several different dimensions or traits.

The principal difficulty in trait theories is to define meaningful traits and determine how many we need in order to describe an individual personality. In effect, every variation in behavior that can be measured objectively can constitute a trait. Thus we have a general trait of intelligence which can be broken down by factor analysis into verbal comprehension, word fluency, number ability, and others. We have traits in the area of motor skills, which are not so well defined. We have artistic and musical traits, each of which represents a cluster of abilities. When we get into the area of emotional and social traits—those characteristics which we think of particularly as "personality traits" —the problem of definition is even more difficult. We have the nine scales that make up the MMPI, and many more. There are scales of extroversion-introversion (outgoing-inturning), ascendency-submission, sophistication-simplicity, conformity, emotional stability, and so on. Even when we identify clusters of traits by factor analysis, we are not sure that

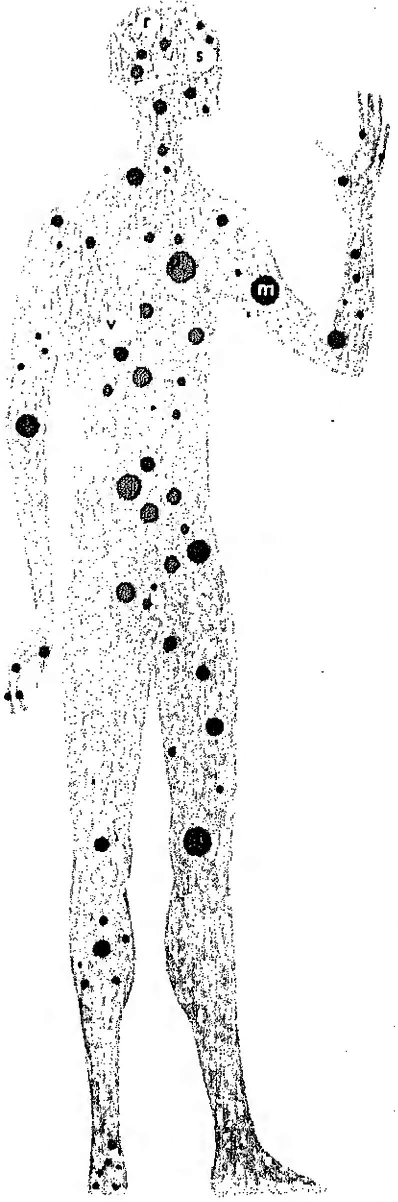
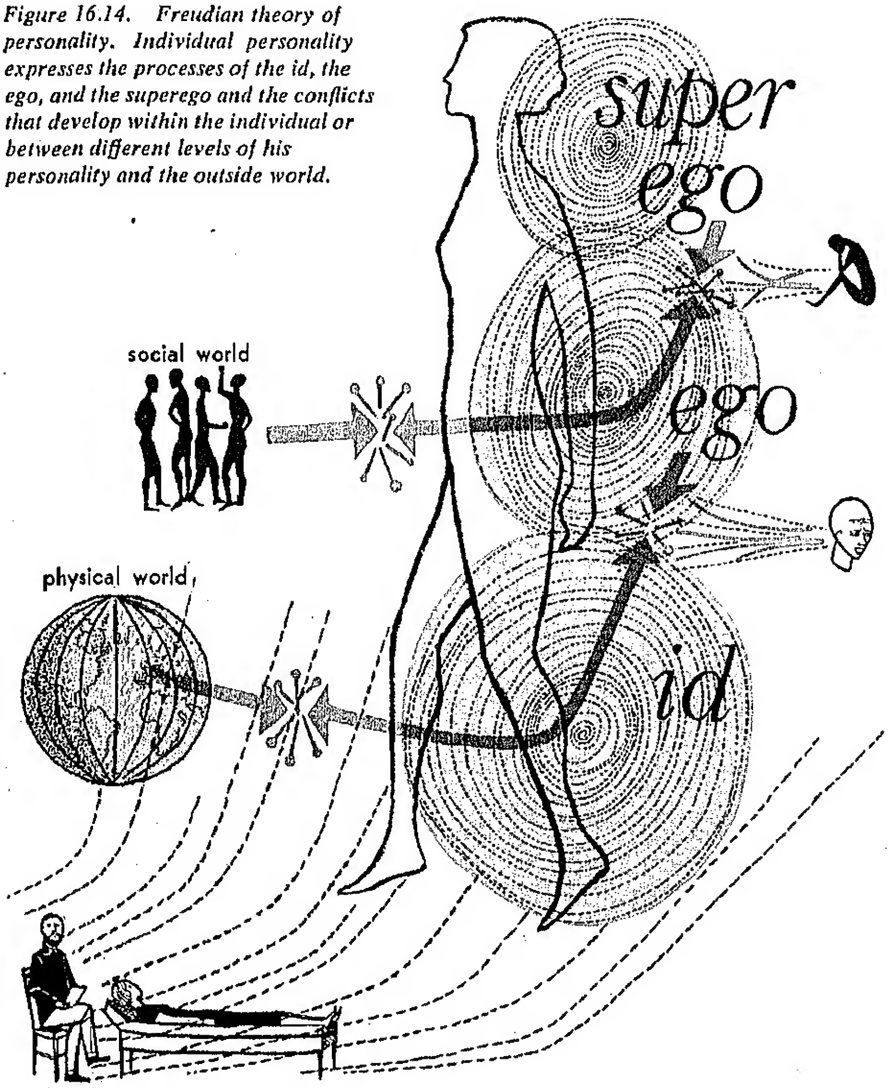


Figure 16.13. Trait theory of personality. If we define personality as made up of specific traits, we must include many abilities, emotional characteristics, and other aspects of temperament. There is no agreement on the number or nature of basic traits.

Figure 16.14. *Freudian theory of personality. Individual personality expresses the processes of the id, the ego, and the superego and the conflicts that develop within the individual or between different levels of his personality and the outside world.*



they are independent variables, or exactly how they should be described in objective terms. The most recent comprehensive attempts to identify the so-called basic traits do not agree on either their number or their designation.[16]

Many psychologists have felt that an overall understanding of personality goes beyond description of traits. Individual behavior represents a well-organized continuum, not a series of independent tendencies, or ways of responding. Certain other approaches to the problem of personality have tried to identify the organizing principle.

Motivational Theory. Out of the Victorian atmosphere of the nineteenth century came a conception of human behavior so revolutionary that its significance is still being assessed: the psychoanalytic theory of Sigmund Freud.[17] We have referred to Freud again and again throughout this book, for his thinking has influenced our ideas of development, of motivation, of learning, of thinking—in fact, of almost every aspect of behavior. While we cannot go into all of the complexities of psychoanalytic thinking, we are going to describe the outlines of Freud's conception of personality.

Freud believed that personality is an expression of three interacting internal processes, the *id*, the *ego*, and the *superego*, which we see diagrammed in Figure 16.14. Man's basic motivation for behavior in the id is instinctive, unconscious, and essentially sexual in nature. In Freudian theory, all pleasure seeking and aggression are derived from the id. In seeking pleasure, the id must interact with the outside world and its restrictions and punishments. Thus the ego is developed, which represents the level of personality concerned with events in the physical and social environment. The third level of personality, the superego, is the critical self, the internalization of rewards and punishments, which develops when the individual takes over the restrictions and prohibitions of the parents as a part

of himself. The superego is one's conscience, the origin of guilt feelings and of the idea of sin. One can hate others with his id, but he needs a superego to hate himself.

These three levels of personality serve different purposes, thus causing conflicts among them and in relation to the environment. The ego attempts to satisfy the instinctive desires of the id in the outside world. However, the superego "clashes" with the ego when socially disapproved id impulses are directly expressed. A severe conflict between ego and superego is presumed to be the cause of many expressions of behavior disorder. The "defense mechanisms" which we discussed in Chapter 3 as frustration reactions—compensation, rationalization, projection, and the like—are methods by means of which the motivating power of the id can escape without incurring the wrath of the superego. Freud interpreted dreams, fantasy, slips of the tongue, and even jokes as being motivated by impulses from the id.

An important part of Freud's theory stated that there are several stages of psychosexual development in man—oral, anal, phallic, oedipal, latent, and genital—which represent differences in the nature and direction of sexual impulses. In the oral stage, the infant's desires are gratified through the mouth. The anal stage corresponds roughly with the toilet-training period of child development. The release of tension through excretion, which is assumed to be a primary source of pleasure for the child at this time, is now subject to social control. The manner in which this control is imposed and the nature of the child's reactions to it are thought to have far-reaching effects on later characteristics of personality. In the phallic stage the child's interest and personality development focus on his sexual organs and specific sexual feelings—but not on sex objects. It is during the oedipal stage that sexuality is directed away from the self to other people and objects. The classic "Oedipus complex" is defined by positive sexual feelings directed toward the parent of the opposite sex, whereas the parent of the same sex is the object of hostility and aggression.

These first stages represent the dynamics of personality growth during the first five years or so. The next five or six years is the latency period, during which time impulses, conflicts, and feelings associated with the early stages are repressed, only to "bloom" again when the genital stage is reached. This last stage begins in adolescence and terminates in normal heterosexual adjustment.

As the child passes through these different stages of personality development, his id impulses are sometimes directed outward to the mother, father, siblings, friends, or objects, while at other times the impulses are autoerotic, directed toward himself. The id is described as indiscriminate—any person, object, or event can be its "target" if tension of the id system thereby is reduced. In this way, analytic theory tries to account for the many perversions, obsessions, and peculiar forms of behavior observed in some people. Conflict between the id, the ego, the superego, and the outer world can occur at any and all of the stages described. If during a particular stage a major conflict is not resolved, the individual becomes fixated at that stage, and is unable to progress through subsequent stages to satisfactory heterosexual adjustment. The id impulses which produce the

conflict and the conflict itself are repressed from conscious awareness. Thus the principal function of the psychoanalytic interviewer is to probe the unconscious realms of personality in order to reveal hidden impulses and conflicts so that they can be dealt with realistically.

Although Freud's influence always has been strong in the field of personality study, many psychologists have been disinclined to accept his conceptions in psychoanalytic terms alone. Present-day motivational theory of personality among experimentalists speaks of the biological basis of personality and its physiological motivation rather than the id, conditioning and operant learning rather than the ego, and learned social constraints and motives rather than the superego. However, conflict, anxiety, and frustration as organizing forces in adjustment are as important to non-Freudian motivational theories of personality as they are to the psychoanalytic conception.

Social-perceptual Theory. While trait theories are concerned mainly with systematic descriptions of behavior, and motivational theories with the driving forces within the individual that organize behavior, there is another approach which emphasizes the importance of the environment as a determining factor. In particular, the social environment is recognized as defining the developing personality. This idea was explored in some detail in our chapter on Social Behavior.

One formulation of social-perceptual theory is the field theory, or topological psychology, of Lewin.[18] In this view, the individual is the center of a "life space" or behavioral field in which his behavior is determined by the attracting and repelling forces acting upon him. The life space cannot be described in physical terms, but depends upon the individual's perceptions of the objects and people in his environment. The notion of conflict is as important in Lewin's theory as in motivational theory, but here the conflict is thought of as being between opposing forces in a dynamic field, instead of essentially within the individual.

Personality can be thought of as organized around the attitudes, ideals, or beliefs that the individual gradually learns from his social-cultural environment. Thus specific responses to the environment are defined by general modes of perceiving objects and events, and the values which are attached to different kinds of behavior. Religious beliefs are important organizing principles, as are other social and cultural values.

Social-perceptual theory, more than any other general approach, emphasizes the role of society and culture in the development of the personality. Some of the most important contributions of Lewin and his students have been in the area of social psychology. The study of the influence of authoritarian, democratic, and laissez-faire social "climates" on the behavior and effectiveness of boys' groups (see page 396f.) is an example. However, in this approach, as in others, personality must be thought of as a function of a motivated individual reacting to his perceived environment. With Freud the main emphasis is on motivation; with Lewin, on the social-perceptual environment.

The Importance of Learning. By this time, the student will realize that the theories or models of personality organization are not mutually exclusive, and

that no one of them is entirely satisfactory. Each theory tells us something about the behavior of man, and constitutes an approach to personality study and measurement. A common factor in all of them is the recognition that the specific patterns of behavior which serve to structure personality are dependent on the past experiences of the individual. The best statement of trait theory is that personality traits are sets of similar learned responses or habits. In the more recent experimental formulations of motivation theory, the responses which an individual adopts to alleviate his anxieties and conflicts are attributed to learning. Further, the motives themselves are believed to be in part learned, in particular those social and emotional motives which are so important in determining the course of adjustment. Finally, social-perceptual theory holds that the perceptions, attitudes, or beliefs that serve to organize personality are learned by the growing child in response to the cultural and social groups which make up his human environment.

How then can we look on personality—as a set of traits, motives, perceptions, or all three? Our problem is simplified if we realize that personality does not have to be a special thing, organized separately from the rest of the behaving organism. In a sense, our whole study of human behavior has been a study of human personality; how it develops in the interplay of motivation, perception, and learning, and how it is described in behavioral terms. Personality is an expression of the individual's adjustive response patterns in all the different situations that structure his life. The characteristics of personality are the characteristics of adjustive behavior, which we introduced in Chapter 2. Motivation, perceptual organization, and social organization are all determining factors, and as these factors change, personality itself is subject to change. Studies of the consistency of measured personality characteristics show that, in general, observed changes follow the broad patterns of individual development and adjustment throughout life.

Changes in Personality with Age. The formative years of childhood and adolescence witness rapid changes in physical and physiological development, and related changes in personality or adjustive behavior. Interests change rapidly throughout these early years until the middle twenties, when they have begun to stabilize.[19] Children and adolescents are interested in vigorous physical activities, which give way to the more noncompetitive and sedentary interests of adulthood. Patterns of motivation also change with age. Sexual-social motivation generally reaches a peak in late adolescence or the early twenties. Thereafter, most individuals are motivated more in areas related to their jobs and vocational success.

In general, the emotional and social habits that characterize the individual are the core which represents stability in personal patterns of response. Thus the measurable traits of personality tests are relatively stable, although we sometimes see radical changes in the behavior disorders. The determining factors which lead to such changes, as we shall see in the next chapter, can be identified only in part. There have been some attempts to relate neuroticism, emotionality, and other measures of general adjustment to age periods, but the results are inconclusive. Even the common belief that women are more sub-

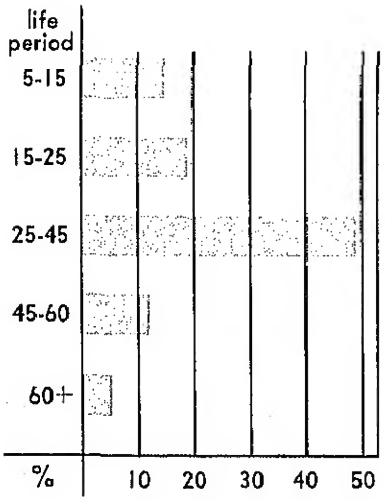


Figure 16.15. The happiest periods of life. The graph shows the judgments of several hundred old people as to what period of their lives had been the happiest. (Based on Morgan, C. M. The attitudes and adjustments of recipients of old age assistance in upstate and metropolitan New York. *Arch. Psychol., N. Y.*, 1937, 30, No. 214.)

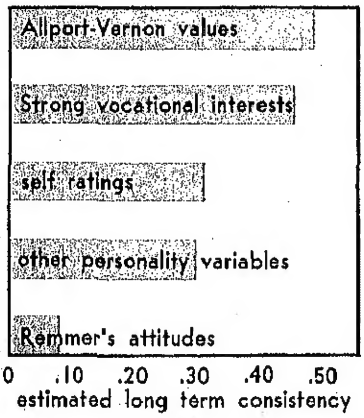


Figure 16.16. The stability of measurements of personality variables over a 20-year period. (Based on Kelly, E. L., Consistency of the adult personality. *Amer. Psychol.*, 1955, 10, 659-681.)

ject to disturbances during the menopause than at other times has not been substantiated.

One way of assessing the general trend of adjustment throughout life is to see what ages appear happiest in retrospect. The bar graph in Figure 16.15 shows the judgments of several hundred old people as to what period of life had been the happiest. Approximately half of them thought they had been happiest in the early adult years. Most of the rest judged childhood or adolescence the happiest years, while only a few thought they had been happiest after forty-five. The middle years were judged happiest because of family and personal relationships, and the more varied activities which occupied those years. A number of studies point out that satisfactory adjustment is partly a matter of maintaining active interests, but that as people grow older they dislike undertaking new activities which disrupt established habits. Thus the general picture we get of personality changes throughout life is of rapid, flexible changes during the early years, leading to a broad scope of interests and activities during early adulthood, which gradually become more rigid and decrease in number during aging.

Stability of Adult Personality. In spite of the changes that occur in personality with age and with other radical changes in environmental or physiological variables, in general the measured personality patterns of adults remain relatively consistent for many years. We get a more precise picture of the characteristics that show the greatest stability in a study of several hundred adults over a 20-year period. In the 1930's, 300 engaged couples agreed to participate in a marriage study and were given a number of personality tests. Twenty years later most of these same people were contacted and agreed to be retested. These test-retest data were obtained from 176 men and 192 women, of whom 116 couples were still married to each other. Five different groups of personality variables were tested, as indicated in the bar graph in Figure 16.16. These estimated consistency measures were obtained from correlating individual test scores before and after the 20-year period.

The most consistent of the measured characteristics were those values measured by the Allport-Vernon Scale. This scale is designed to measure six basic personality interests: theoretical, economic, esthetic, social, political, and religious. Five of the variables in this scale have reliability coefficients around .70 to .75 when retested after one year. For the 20-year period, the test-retest correlations were around .50 to .60. Similar measures of consistency were found for vocational interests. The self-ratings of personality and several other personality measures showed somewhat more change over the years, but the surprising result was the very low stability of attitudes, as measured by the Remmers' Generalized Attitude Scales. These scales measure attitudes toward marriage, church, rearing children, housekeeping, entertaining, and gardening. The retest correlations after 20 years were lowest for attitudes toward marriage and rearing children.

Many people think that the intimate relationships of marriage tend to make man and wife more and more alike over the years, but the results of this study indicate that they retain their individuality. The 116 couples who were first tested as

engaged couples and then retested after many years of marriage showed about the same similarities and differences both times. If anything, they tended to become somewhat less similar through the years.

According to the results of this study and others, we can look on personality as relatively stable, although subject to gradual, continuous changes which occur throughout life. The more general reactions in the areas of value judgments and vocational interests are more stable than the more specific attitudes measured by the Remmers' Scales. The broad motivational patterns of adult life are maintained while the specific likes and dislikes vary.

What is the best explanation of the stability in adult personality, as indicated in the studies just described? First of all, we should note that individual abilities such as intelligence and many other critical aspects of adjustive behavior are very much the same from year to year. The consistency of values and interests is no doubt related to the relatively unchanging level of verbal and perceptual abilities in the middle years of life. Furthermore, we should remember that adjustment is an expression of many levels of vital interaction—chemical and physiological, as well as behavioral on the individual and social levels. In its consistency and in its variability, personality reflects the integration of all these many kinds of activities. The values and interests which we hold fast through war, crises, and social change are associated with internal motivational and emotional activities which help define the individual's psychological needs. The stability of personality from year to year and from decade to decade is in part a product of the physiological and psychological inertia of the living system.

However, exceptions to the general rule of stability exist in personality organization. An individual can tolerate conditions of stress only within limits. Under extreme stress and frustration, whether it originates internally or externally, we observe radical departures from the usual course of adjustment, leading to marked readjustment or behavior disorders. As we shall learn in the next and concluding chapter of the book, the behavior disorders, like the more ordinary patterns of behavior, are expressions of individual adjustment to particular conditions of the internal, external, and social environments.

SUMMARY

Systems of personology—humoral theory, phrenology, graphology, and constitutional types—are attempts to classify personalities according to over-simplified systems of structural or behavioral variables. Their limited usefulness is indicated by their ineffectiveness in predicting behavior.

Self-inventories sample a person's opinions of his own behavior and attitudes. The most carefully standardized inventory, the MMPI, was constructed by the item analysis method, whereby items were selected for nine scales that differentiated between a normal group and nine abnormal groups. It contains several scales constructed to detect faking or lying. MMPI profiles are generally consistent except in some individuals subjected to drastic physiological or environmental changes.

Projective tests are situations which a person interprets freely according to his own feelings and attitudes. Examples are

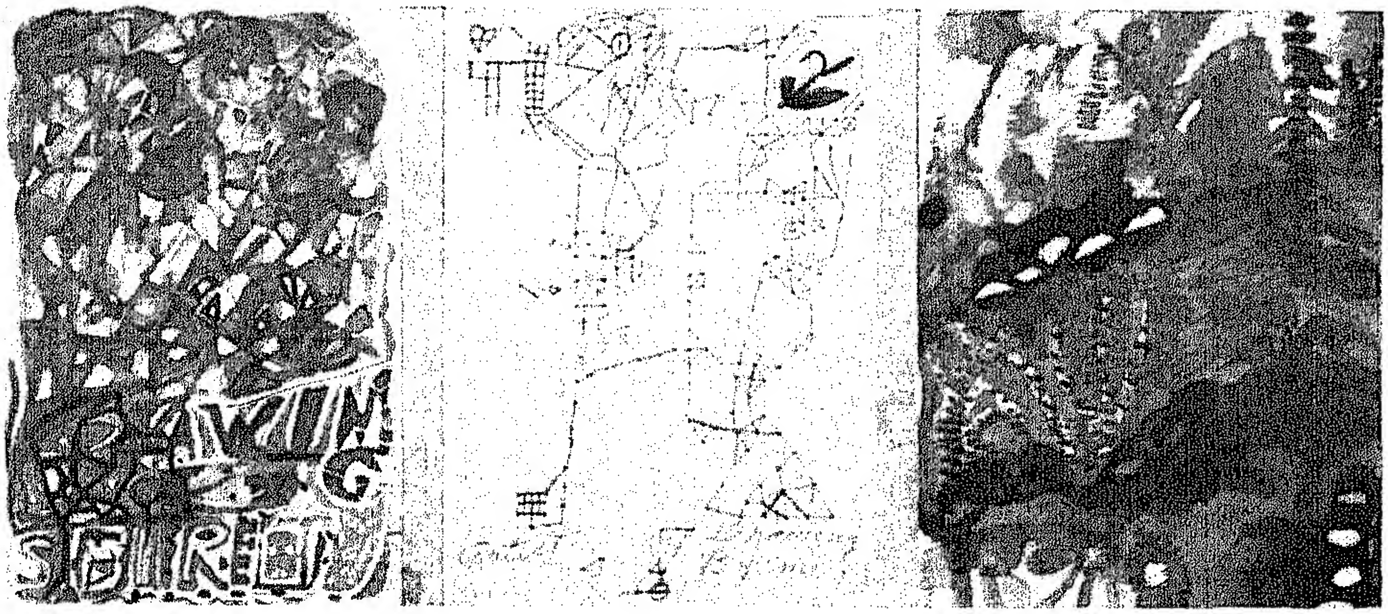
Blacky Pictures, the Rorschach Test, Thematic Apperception Test, Make-a-Picture-Story Test, and the Picture Arrangement Test. The latter is the most carefully standardized and objectively scored.

Personality can also be assessed by interviewing—e.g., the patterned interview, nondirective interview, and psychoanalytic interview.

The various methods of personality assessment differ in their use and advantages. Inventories are the best standardized, the most objectively scored, and the most reliable. However, projective tests and interviews are thought to be more helpful in analyzing the total personality.

Both inventories and projective tests can differentiate between normal groups and groups of people with varying degrees of behavior disorder. No one method is very successful in predicting individual adjustment, although interviews as well as inventories and projective tests are fairly successful in group selection. Perhaps the most effective use of personality assessment methods in individual prediction is to use inventories for screening, and then follow up with more thorough evaluation using other methods.

Theories of personality emphasize different factors which contribute to personality structure. Trait theory emphasizes consistencies in response patterns. Motivational and social-perceptual theories look for an organizing principle in individual drives or perceptions of the social world. All of them recognize the importance of learning in personality development. The characteristics of personality change most rapidly during the early formative years, and become relatively stable in adult life.



Theme. The two paintings and drawing above were made by a hospitalized patient diagnosed as schizophrenic. He had a seventh-grade education and no formal training in art. The painting on the left was made early in his illness, while the center drawing and the painting on the right were made later. The art of seriously disturbed patients may be disorganized but still show evidence of great talent and controlled skill.

CHAPTER 17. THE BEHAVIOR DISORDERS

Our study of human behavior leads us inevitably to a consideration of some of the special problems posed by the socially inadequate patterns of adjustment known as behavior disorders. We approached this area tentatively in the early chapters, where we learned that some individuals under extreme stress or conflict do not make satisfactory adjustments, but display various degrees of disturbed behavior. There are many kinds of behavior disorder, ranging from relatively mild problems of adjustment to the serious psychoses which necessitate hospitalization. As a general term, behavior disorder refers to any persistent limitation or disturbance in adjustment which acts as a barrier to the individual's fulfilling a satisfying role in society.

There are three aspects of disturbed behavior which we are going to consider in this chapter: the description and analysis of different kinds of disorder, their treatment by psychotherapy and other techniques, and their prevention through a better understanding of the course of adjustment. Actually, behavior disturbances rarely are studied except in the therapeutic situation. A behavior disorder is, by definition, a pattern of behavior which needs treatment, according to the opinion of the person himself or his associates. Thus much of what we know about behavior disorders is based on clinical evidence

from psychiatrists and clinical psychologists, although in recent years there is a trend toward controlled experimentation in this field. By combining our knowledge derived from therapeutic practice with what we learn from the experimental study of both normal and abnormal behavior, we shall gain insight into behavior disturbances and how they can be treated and prevented.

Since psychotherapy provides an important avenue by means of which we study and analyze the behavior disorders, we should consider just what we mean by this term. Psychotherapy refers to treatment by psychological means. It is sometimes used in a limited sense to indicate treatment by professionally trained psychologists and psychiatrists, but in a more general sense it means any process of sustained communication which helps to alleviate disturbances in adjustment. It is basically a learning situation, or, rather, a relearning situation. The process is most often interpersonal in nature between the person who gives help and the disturbed individual who comes to him, but in some cases psychotherapy is carried out in a group, where social interaction in the group is one of the critical factors.

KINDS OF BEHAVIOR DISORDER

Throughout history, the behavior disorders have been a source of great suffering for the individual and his associates, and a serious problem for society. Since these disorders have not been understood, treatment has ranged from ostracism and ridicule to punishment and death. As an object of fear and scorn, the patient in an asylum had passed the point of no return. With no real understanding of his trouble and no effective treatment, there was little hope or expectation of his return to normal life.

In recent years the attitude toward behavior disorders has changed, as psychology and medicine have made some progress in understanding and treating these problems. We no longer believe that the behavior of an "insane" person is qualitatively different from normal behavior. In fact, we are gradually dropping our use of the term, and with it the outmoded concept of "insanity." For a long time, the most prevalent notion was that disturbed behavior is a kind of disease, a mental illness. Even that idea is being revised. The disturbed individual is looked upon as a person who needs help. His patterns of adjustment are not ordinary, successful patterns, and he may exhibit exaggerated forms of behavior, but such behavior patterns need no new psychological principles of description.

Organic Behavior Disorders. Disturbances in adjustment that can be traced to a *known* physical condition are referred to as organic disorders. In this category we include many behavioral problems which are due to physical handicaps. The little girl in Figure 17.1*a* has a deficiency in motor coordination which prevents normal walking. She needs to be fitted with orthopedic shoes and requires prolonged training and care. The deaf children in Figure 17.1*b* will need many years of training in the skills of social communication, as well as constant encouragement in their efforts to make an independent adjustment. The boy being helped in Figure 17.1*c* has a more serious condition, cerebral palsy, which results in general

deficiencies in motor coordination and, in this case, intellectual retardation. He needs almost constant care. Cerebral palsy is a serious condition caused by injury to the central nervous system.

Most cases of intellectual retardation may be considered organic disorders, although it is not always possible to describe the nature of the deficiency in physiological terms. As we have seen, genetic factors set limits on the development of intelligence, which no amount of training or special care can overcome. Of course, there are many cases of retardation, such as the child with cerebral palsy, which can be attributed to actual injury to the nervous system. The retarded child needs special training which is adapted to his ability to learn and to his personal needs and emotional difficulties. In treating the physically and intellectually handicapped, we make no sharp distinction between education and psychotherapy.

Some of the *psychoses*, which are the major forms of behavior disorder, have a known or suspected organic origin—e.g., alcoholic and senile psychoses, which are probably both due to destruction of nervous tissue. General paresis is a psychosis which occurs when the germ of syphilis infects the brain. Fortunately, modern methods of controlling syphilis are very largely eradicating this disorder.

Functional Behavior Disorders. By far the most difficult disturbances to understand are those which have no *known* organic basis. In this class we include the *behavior problems* and *neuroses,* as well as most of the psychoses. We call these the functional disorders, implying that the individual functions in an abnormal way without known structural defect. This

a

b

Figure 17.1. Organically determined behavior problems. Many disturbances in behavior arise from organic deficiencies. To make a satisfactory adjustment, these children need years of special training and, in some cases, psychotherapy. (Courtesy Madison, Wis., Board of Education.)

c

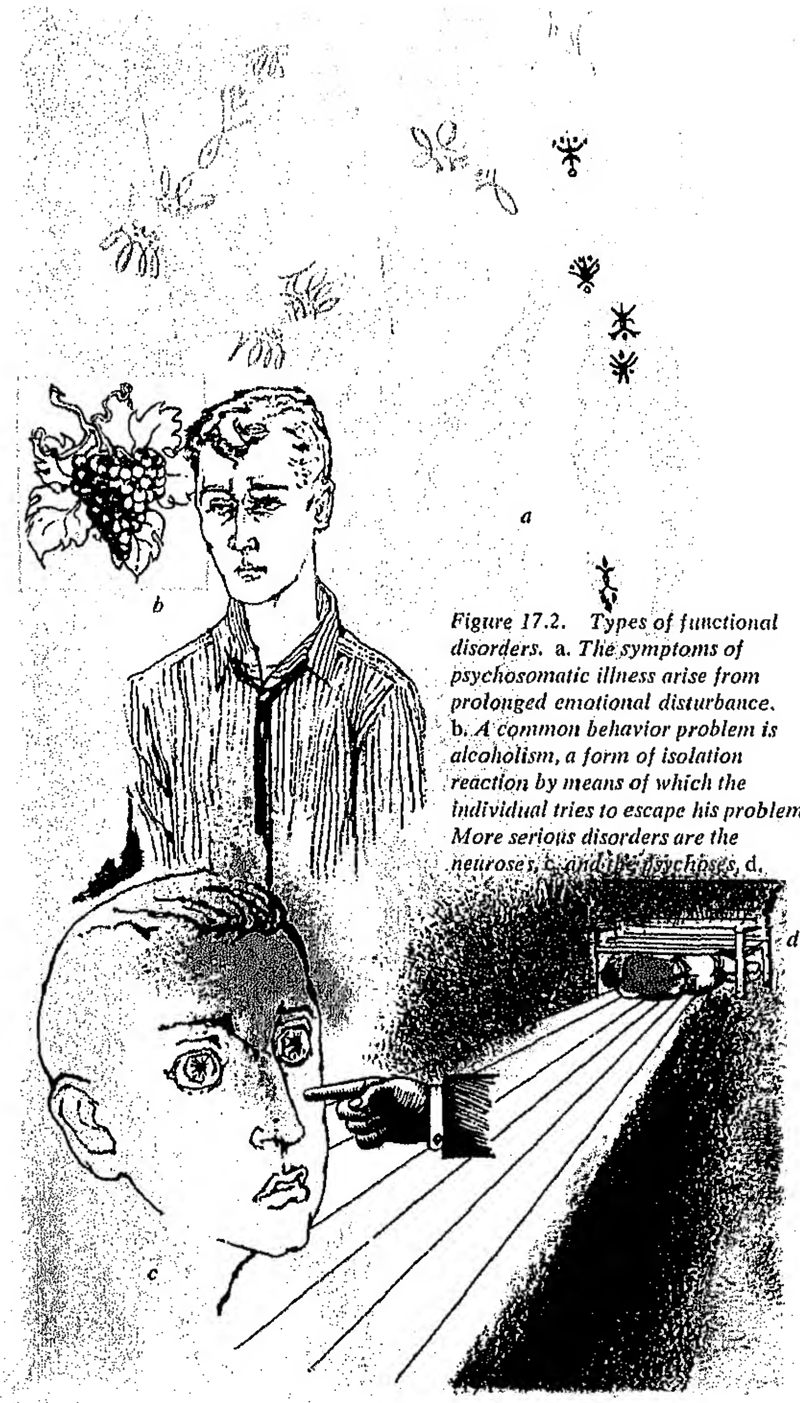


Figure 17.2. Types of functional disorders. a. *The symptoms of psychosomatic illness arise from prolonged emotional disturbance.* b. *A common behavior problem is alcoholism, a form of isolation reaction by means of which the individual tries to escape his problems. More serious disorders are the neuroses,* c, *and the psychoses,* d.

is not to say that a functional disorder has no correlated bodily disturbances, for, as we have seen, emotional disturbances can involve profound physiological as well as psychological reactions. Our present understanding of the functional disorders is that they originate as learned patterns of adjustment. Four general types of functional disorders are illustrated in Figure 17.2, psychosomatic disorders, behavior problems, neuroses, and psychoses.

We have already learned in Chapter 7 that prolonged after-effects of emotion in some cases induce physiological symptoms and illness. Ulcers, high blood pressure, and colitis are examples of psychosomatic disorders which can be brought on by the disruptive effects of prolonged emotional disturbance. There are some medical and surgical techniques for treating psychosomatic symptoms, but the underlying emotional disturbance is a problem for psychotherapy. More than medical aid, the individual needs help in reorganizing his life and learning new habits of adjustment in order to reduce the effects of emotion and frustration.

We use the general term "behavior problem" to describe many response patterns that represent inability or failure of an otherwise normally reacting individual to deal with some life situation according to his needs or the standards of society. The individual who isolates himself from others by the use of alcohol, as represented in Figure 17.2*b*, is one example. We shall describe the behavior problems at greater length in the next section.

The psychoneuroses, or neuroses, are behavior patterns characterized by anxiety and the special ways a person learns to defend himself against it. The anxiety is usually the result of conflicting motives.

In many instances, the person himself is not aware of the conflict underlying his trouble, and his behavior is more of an attempt to relieve the anxiety than to resolve the conflict. For this reason, neurotic behavior often appears peculiar, and unrelated to the person's everyday needs. The neurotic in Figure 17.2*c* is pictured as a person disturbed by feelings of guilt. In the neurotic such guilt feelings can occur frequently for no apparent reason, and are usually accompanied by pervasive anxiety and unhappiness.

In contrast to the neurotic, the psychotic individual is usually so severely disturbed that he cannot react adequately to the world around him, and thus cannot conduct his own affairs. It is usually the psychotic who is committed to a mental hospital and is legally defined as insane.

General Symptoms of Behavior Disorders. The classes of functional disorders which we have described briefly cannot be distinguished in terms of their causation, which is usually unknown or not clearly understood. Nor can they be differentiated with any great precision in terms of the nature of their symptoms, except possibly in some of the more severe disorders. Our classification is a practical one, based principally on the number and severity of symptoms, as well as on the type of treatment to which the disordered individual responds.

The symptoms of behavior disorder may appear in any or all of the dimensions of behavior—motivation, emotion, perception, motor coordination, intellectual ability, learning, and so on. A primary mark of disturbed behavior is related to disturbed motivation; the individual shows a pronounced change in motivation marked either by apathy, or hyperactivity with no apparent goal. Emotional symptoms can include unusual fantasy, anxiety, depression, morbid fears, and rage. Hallucinations, or perceptions which have little or no basis in external reality, are a fairly frequent symptom of psychosis. At the other extreme, there may be a complete failure of some kinds of perception, such as functional deafness—that is, deafness with no structural basis. Many types of motor disturbances are seen, such as tics (uncontrolled repetitive movements), disorders of speech, and partial paralysis. Intellectual deterioration sometimes occurs in extreme cases of disorder. Especially in psychotics, thinking and reasoning are often impaired, and the individual may develop delusional beliefs. Among the symptoms involving learning and memory, amnesia is the most striking. In some cases of behavior disorder, certain groups of symptoms, called syndromes, recur in much the same form in different individuals. The different kinds of psychoses which we shall describe later represent syndromes of disturbances.

The symptoms of the behavior disorders do not differ qualitatively from normal patterns of response. All of us exhibit some of these symptomatic forms of behavior at one time or another, *to some degree*. Apathy, hyperactivity, hallucinations, anxiety, tics, delusions—these are not extraordinary forms of behavior, and their *occasional* appearance cannot be taken as a sign of disturbed personality. But in the behavior disorders these symptoms appear more often, in greater numbers, and in exaggerated forms. Thus we say that disturbed behavior is quantitatively, but not qualitatively, different from normal behavior.

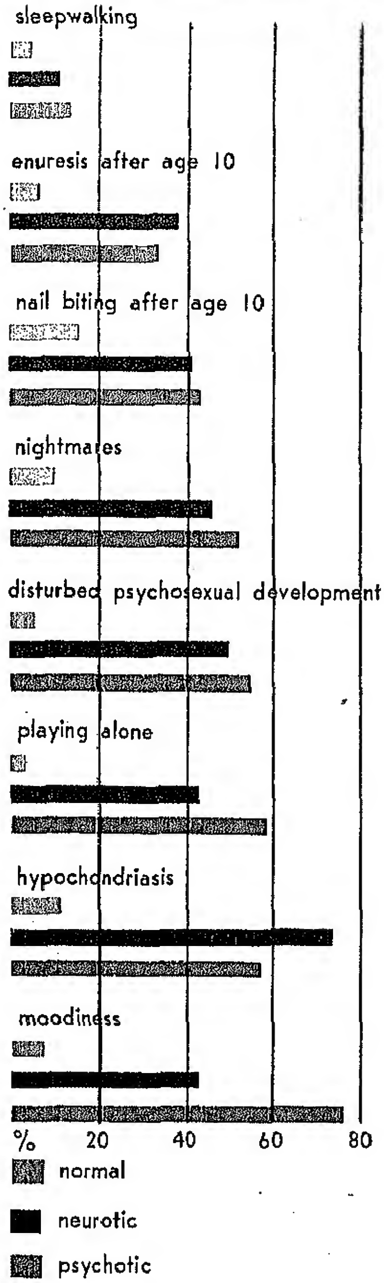


Figure 17.3. Occurrence of symptomatic behaviors in normal, neurotic, and psychotic soldiers. Many behavior patterns which are symptomatic of disturbances are found to a lesser extent in individuals considered normal. [Data from O'Kelly, L. I., and Muckler, F. A. *Introduction to psychopathology* (2nd Ed.). Englewood Cliffs, N. J.: Prentice-Hall, 1955.]

The difference in symptoms between neurotics and psychotics, while clear-cut enough for diagnostic purposes, in most cases is still one of degree, with psychotics generally exhibiting disturbances in more areas and in more exaggerated forms than neurotics. To illustrate this point, we can cite a study of the relative occurrence of eight common symptoms of disorder in three groups of soldiers described as normal, neurotic, and psychotic. In Figure 17.3 we see that each of these behavior patterns which is associated to some extent with behavior disorder is found also in individuals described as normal. In general, the psychotic group displayed these eight disturbances more frequently than the neurotics, although there was a greater incidence of enuresis (bedwetting) and hypochondriasis (unfounded feelings of illness) among the neurotics.

It is evidence such as this that convinces us of the inadequacy of the "disease" approach to the behavior disorders, with its implication that some definitive cause or set of causative factors can be found which differs for each different disorder. The problems with which we are dealing are manifestations of human behavior, and to treat them we must understand how behavior develops and how it can be changed. All forms of behavior develop as a result of the interacting effects of many different variables, both within the individual and in his physical and social environment, and the behavior disorders are no exception. The problems of treatment are made more difficult by the fact that the critical pattern of causative factors differs from one person to another. When it is possible to identify some relatively specific organic or environmental inadequacy that can be corrected, the course of treatment naturally is made easier. However, we must always bear in mind that in most cases of disturbed behavior there is no simple cause, and there can be no simple solution.

BEHAVIOR PROBLEMS

The symptomatic reactions indicated in Figure 17.3 occur in individuals who are judged to be normal, as well as in neurotic and psychotic persons. When they occur in normal people, they constitute behavior problems, or restricted types of disturbed behavior in individuals who otherwise have made a satisfactory adjustment. The relatively restricted behavior problems are nonadjustive reactions which are troublesome to the individual and often to others. Furthermore, their occurrence indicates emotional disturbances which can lead to more serious difficulty. Thus the early detection and treatment of the behavior problems is important as a preventive measure.

Types of Behavior Problems. We can distinguish four general classes of behavior problems—namely, specific disturbed reactions, antisocial behavior, sexual aberrations, and isolation reactions. These reactions are nothing new in human behavior, but are probably as old as civilized man. Figure 17.4 shows segments of engravings from the eighteenth-century satirist, Hogarth, picturing some very familiar behavior problems.

Specific disturbed reactions include stuttering, nail biting, uncontrolled muscle twitches or isolated movements which are known as *tics*, enuresis, unreasonable fears, and other disruptive reactions. These

habits usually develop in childhood and are quite resistant to change. They apparently are related to sustained emotion and anxiety.

Antisocial reactions need no comprehensive description, for they are as well known today as in Hogarth's time. They are exemplified by the rebellious individual as well as the delinquent and criminal. Antisocial individuals are in conflict with society, and do not accept many of its values. This rebellion is typically a situational reaction, a pattern of behavior defined by the particular nature of the individual and the social climate in which he reacts. Delinquents are usually a product of early frustration, reacting aggressively against society as a result of their personal troubles and insecurities.

Those individuals who develop unacceptable methods of achieving sexual satisfaction in some cases do so as a result of strong anxiety and conflicts concerning sexual activities. If a child's early family life is unhappy, or if he is taught by a parent that sex is "dirty" or "sinful," he may be unable to learn the ordinary, socially approved habits of sexual expression. Some sexual deviants who are unable to achieve normal heterosexual attachments find their only satisfaction in masturbation, homosexuality, or the activities of the exhibitionist or voyeur. Although we believe that sexual aberrations in some cases are defined by the individual's reactions to his social environment, it is hard to account for all the variations in sexual behavior by learning alone. The possibility remains that organic factors, such as hormonal balances, influence the course of sexual adjustment.

However, the occurrence of homosexual behavior is sometimes a matter of the im-

a

b

Figure 17.4. Behavior problems in human society. Hogarth's eighteenth century recognized the same basic disturbances in social adjustment that we do today. The three types of behavior problems illustrated here are antisocial behavior, a, *alcoholism,* b, *and sexual aberration,* c.

c

mediate environmental situation. Institutional living, as in reform schools, prisons, and so on, encourages homosexual activities because of the restriction on heterosexual contacts. Individuals who engage in such activities in a restricted environment do not necessarily continue them in other situations.

The term "isolation reactions" refers to strongly motivated habits of escape from pain or the discomfort of social situations. Social isolation may take such forms as refusals to attend large social gatherings, choosing a job with few social contacts, or the extreme isolation of the hermit or recluse. Escape reactions with more serious consequences to the individual and society are those of alcoholism and drug addiction. The alcoholic does not actually leave the unpleasant, tension-producing situation, but he avoids for a time his feelings of anxiety by drinking. Since the basic problem or conflict is still there, the person who learns to use alcohol to "avoid" it becomes strongly motivated to continue this method of escape. The use of drugs also produces feelings of well-being, relaxation, and contentment.

Treating Behavior Problems. The behavior problems as we have described them have until relatively recent years been ignored, ridiculed, or punished, but not treated in any systematic or understanding way. The tremendous growth of clinical psychology in the last few decades reflects our growing awareness of the importance of treatment in this field. Medically trained psychiatrists work mainly with neurotic and psychotic individuals, but many of the behavior problems are dealt with very effectively by clinical psychologists working in schools, child guidance clinics, counseling and diagnostic centers, alcoholic centers, prisons, hospitals, and other institutions throughout the country.

The general concepts that guide clinical psychologists are derived both from general experimental psychology and from their observations of actual events of adjustment as they encounter them. Foremost among these concepts is that conflict and stress in a social setting, such as the family, the school, or on the job, are prime contributing factors to the occurrence of emotional difficulties, tensions, and frustration. Thus one important aim of therapy is to decrease the intensity of these factors in order to help the total problem situation.

The principal techniques of psychotherapy used in dealing with behavior problems are those we have already become familiar with in Chapters 3 and 16. These include directive and nondirective counseling, play therapy, role playing, and group therapy, as well as special training procedures which are used with such specific disturbances as stuttering. As we have said, psychotherapy involves a process of communication between the therapist and his client. This process is not an end in itself, but is significant only insofar as it enables the individual to achieve a more satisfactory personal adjustment. In treating the behavior problems, we find that psychotherapy is facilitated when it is combined with certain other procedures, such as vocational training, to help restructure individual behavior.

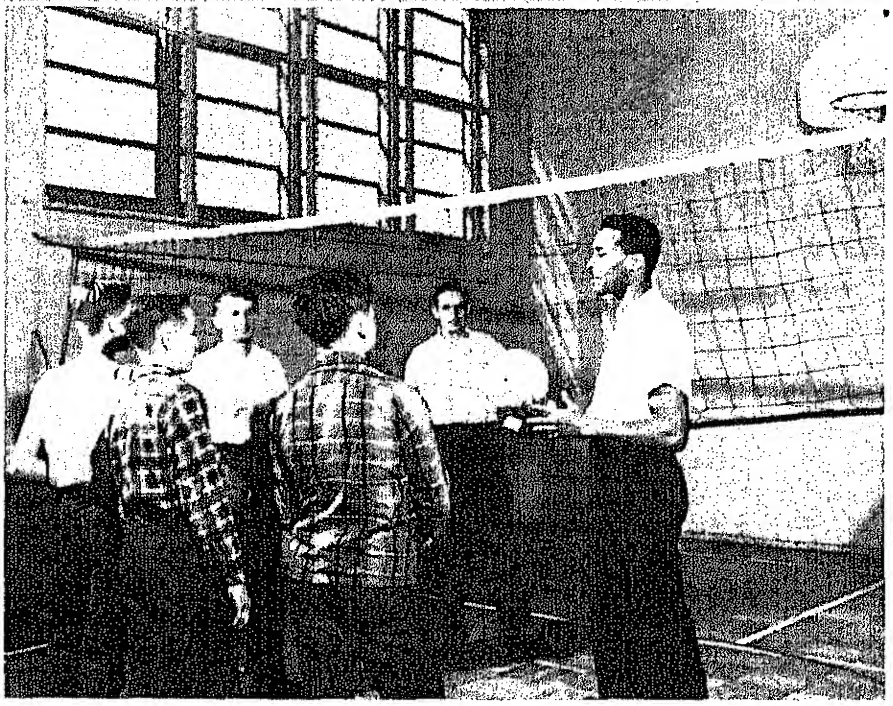
Treating children. Therapy must be adjusted to the age and the special needs of the individual. When we deal with behavior problems in children, the methods we use depend on the developmental level of the child and are directed toward helping

him improve his general competence and skills. Part of the difficulty of a problem child usually is centered around his inability to communicate effectively with others, involving an inadequacy in expressing himself and in establishing satisfying social contacts. A child who develops an emotional problem at an early age is usually seriously retarded in communicative and other social skills.

In the clinics and child guidance centers where problem children are treated, the emphasis is on providing rich and varied opportunities for developing perceptual and motor skills and cooperative social habits. Developing expressive skills in the problem child provides him with an important emotional outlet, as well as increasing his self-confidence in his own abilities. The photographs in Figure 17.5 show children in a diagnostic center for behavior problems undergoing an essential part of their therapy—that is, engaging in cooperative play with other children. Promoting balanced development in the child makes him a happier person, more able to cope with the particular situation in home or school which lies at the basis of his personal adjustment problem.

In treating the problem child, the techniques used are changed during the course of therapy according to his needs. In some cases, one of the first needs may be opportunities for the release of hostility and tension in active play, even to the point of permitting some destructive activity. It is also necessary to establish as early as possible a satisfactory interpersonal relationship between the child and the therapist, to help him gain confidence that he is accepted.

All of the auxiliary techniques that are used to increase skills and self-confidence



a

Figure 17.5. Play therapy in a children's diagnostic center. As important as psychotherapy in the treatment of children's behavior problems is the acquisition of new motor and perceptual skills, as well as the skills of cooperative social living. (Milwaukee Journal Photos.)

b

in the child are preliminary to the main effort—that of recognizing and dealing with the child's particular problems. If the child is old enough and perceptive enough, counseling may eventually deal with his problems verbally. However, it is ordinarily not possible to effect changes in children's hostilities, fears, and other emotional problems through explanations and interpretations, especially if no other approaches are made. For example, the most successful procedures to use in overcoming children's fears are those that help the child gain skill and learn some methods of his own of dealing with the fear situation.[1]

Treating Adults. Psychotherapy is being used increasingly today in dealing with the alcoholic, drug addict, and delinquent or criminal. With adults, as with children, the techniques of therapy for behavior problems are most effective when they are incorporated into a general program of retraining and rehabilitation. The main effort in treating a delinquent or prisoner is in helping him find some useful vocational role in society.

Attempts to carry out psychotherapy with prisoners have a limited effectiveness because of the institutional emphasis on maintaining close custody over the individual. Furthermore, the general social and physical environment of the prison may make constructive psychological treatment difficult or impossible. Really effective treatment of the antisocial person should begin early—if possible, before he has been committed to reform school or prison.

In treating alcoholics, psychotherapy is *only one step toward developing effective* methods of control. It is generally believed that the social life of the alcoholic must be restructured and his motivational pattern reorganized. The value of an organization like Alcoholics Anonymous is in the opportunity it provides for a new and satisfying social adjustment. When the alcoholic finds himself in a group of people who understand his problem and do not condemn him, this outside support strengthens his personal efforts toward control.

Perhaps the most discouraging problem area for the psychotherapist is with the drug addict. A project set up in New York City to treat addicts on a voluntary basis had a staff of 30 professionally trained psychotherapists who gave treatment to any addicts who came to them.[2] Out of an original group of 70 addicts with whom contact was made, 35 actually showed up for therapy. At the end of the project's first year, 22 patients had dropped out after a median number of 8 visits to the therapist. Of the 13 patients who were still in attendance, 10 had stopped their use of drugs and the other 3 had decreased the habit. Apparently, neither the availability of psychotherapy nor its use is sufficient to deal with the problem of drug addiction.

NEUROSES AND PSYCHOSES

The behavior problems are modes of response that disrupt individual and social behavior, but do not involve disorganization of the whole pattern of adjustment. In contrast, the neuroses and psychoses are general patterns of disturbed behavior. Mental health, or psychological health, is often called the nation's number one *health problem*. We can understand the seriousness of the situation if we realize that by conservative estimate about 5 per-

cent of the population will be admitted to mental hospitals at some time during life, while many more will be incapacitated in different ways by disorders brought about by emotional disturbance.

Neurotic Behavior. The distinguishing feature of neurosis is a sustained patterning of reaction involving anxiety, fear, and endless trouble that pervades significant aspects of the individual's life. The neurotic may carry on his daily activities, perform the duties of his job, and maintain his social contacts, but he can no longer escape from continuous tension and anxiety. Many diverse forms of response are developed by the neurotic in his attempts to avoid his difficulties. The common feature in these reactions is their origin in a generalized emotional disturbance.

In some cases, neurotic behavior is precipitated by a *trauma,* or shock. For example, a young wife who lost her first baby by miscarriage responded to the grief and shock by a severe depression which lasted for years. She was convinced that her miscarriage was a punishment and that her life was hopeless. In other cases, a neurosis can develop when there is no apparent external cause. A young man on the way to his wedding experienced a severe attack of anxiety. He trembled, his heart pounded, his breathing became rapid and shallow, and he felt as if he were about to die. Although he was much in love with his fiancee, his mother disapproved of his marriage. His resulting conflict in motives brought on a neurotic anxiety reaction.

Several patterns of neurotic behavior are distinguished in Figure 17.6. These patterns should not be thought of as distinct varieties of neurosis, but rather as typical reactions that can appear, either singly or in combination, as neurotic adjustments to personal problem situations. Although some form of anxiety characterizes all neuroses, we distinguish as our first reaction pattern the general, *diffuse anxiety* displayed by the young man we described above. Besides the features mentioned, diffuse anxiety is characterized by a general restlessness, irritability, nebulous fear, and pervading unhappiness.

A second reaction pattern is the *depression* as we described it in the young wife. The precipitating cause for a neurotic depression is often an event which would cause temporary depression in a normal individual. In a neurotic, the reaction is usually coupled with feelings of guilt, self-abasement, and hopelessness, and it continues for a long period of time. In its principal features the depressive reaction resembles the disaster reaction discussed in Chapter 7, except for its longer duration.

It will be remembered that one of the reactions of frustration is a fixated or stereotyped pattern of response. When carried to extremes, a stereotyped response becomes the *obsession* or *compulsion* of neurosis. By obsession we usually mean a recurring thought which the person cannot "get out of his mind." Sometimes these thoughts seem to be absurd and meaningless, and sometimes they are terrifying thoughts of torturing or killing a loved one. They usually are related to some aspect of the anxiety-producing conflict. Shakespeare's Lady Macbeth was afflicted with a fairly common obsession, that her hands were not clean, and displayed the corresponding compulsive behavior of constantly washing them (Fig. 17.6*c*). The extremely rigid behavior of compulsion is often relatively successful in reducing anxiety. Extreme cleanliness and tidiness help

Figure 17.6. Neurotic behavior patterns. a. *General, diffuse anxiety.* b. *Depression.* c. *Compulsive hand washing.* d. *Phobia, in this case an unreasonable fear of birds.* e. *Hysterical symptom—a "glove" anesthesia.* f. *Dissociation—a "split" personality.*

a person feel that he is not "dirty"—that he does not have socially disapproved sex urges, for example. On the other hand, the rigid requirements of obsessive-compulsive behavior usually interfere with the flexibility of response necessary for adequate adjustment to new situations. Here again we see the similarity between neurotics and the behavior of persons in a disaster, such as the foolish, stereotyped reactions of running in and out of a burning house to rescue worthless articles.

A *phobia*, or neurotic fear reaction, is an intense, unreasonable fear, usually of some environmental object. The girl pictured in Figure 17.6*d* has developed a strong fear of birds. Phobias usually represent a displacement of the anxiety engendered by conflict to some other object or situation which may symbolize the conflict to the individual. We often hear of claustrophobia, fear of closed places. Other fears that develop are of high places, open space, crowds, noise, water, and so on. A severe phobia interferes seriously with the person's daily behavior, for he goes to unusual lengths to avoid the fear-producing situation.

Some of the most striking reactions of neurosis are the conversion reactions, or *hysterias*. By this type of response the neurotic is able to rid himself of his anxiety by converting it into bodily symptoms which effectively remove him from the conflict situation. Hysterical symptoms take many forms—anesthesias, functional blindness or deafness, double vision, "tunnel" vision, paralyses, convulsions, and so on. The girl in Figure 17.6*e* has a "glove" anesthesia, loss of feeling in the covered area of her hand and arm. This loss of sensitivity can be identified as a neurotic symptom rather than a physiological one

because the insensitive area does not follow the distribution of nerves in the hand but corresponds to external topography. Hysterical symptoms are typically of an uncritical nature, approximating what an uninformed person might guess a true bodily disorder would be. Since these reactions often prevent the person from carrying out an unpleasant activity, he may be accused of faking, or malingering. However, a true malingerer is usually very clever about faking symptoms, while the symptoms of an hysterical person are often obviously inconsistent. For example, a neurotic who reports a paralyzed leg might stand on it while taking off his other shoe. Yet for most purposes the leg is actually paralyzed.

One type of hysterical reaction is that of *dissociation*. Occasionally we hear of a dramatic case of a person who develops two (or even three) rather distinct personalities, only one of which is evident at a given time. More often there occurs a flight from a problem situation in the form of hysterical amnesia. The person develops a new personality and completely forgets his former self. Amnesias can also occur as a result of injury or strong emotional shock.

The extent to which neurotic behavior continues in the life of the individual has been studied in cases of traumatic aftermath of war experience.[3] Among 995 neurotic enlisted men from World War II, of whom 35 percent had become neurotic before being assigned to overseas duty, a follow-up investigation after the war disclosed that 54 percent showed improvement, 30 percent showed no change, 13 percent were worse, and 3 percent were not classified. We judge from such reports that there is considerable promise for readjustment of the neurotic to normal modes of living.

The most prevalent views of the nature of neurotic reactions are that they symbolize sex conflict or the expression of hostility and aggression. Thus compulsive handwashing might symbolize preoccupation with the "dirtiness" of sex and masturbation, or a neurotic fear of high places might be interpreted as symbolizing the fear of committing suicide, aggression directed toward oneself. Although it is useful to think of the neuroses as defense reactions against anxiety, there is no reason to believe that this is the only possible explanation, or that they necessarily involve symbolization. The behaviors of neurosis are closely related to the persisting after-effects and habits of emotion. We shall gain a better understanding of the neuroses when we learn more about the organization of emotional behavior in general.

Psychotic Behavior. The functional psychoses present one of the greatest scientific riddles of all time. Psychotic behavior is often so different from what we consider normal behavior that we find it hard to believe that these reactions are exaggerations of ordinary conduct. Yet in the psychoses, as in the neuroses, we see extreme representations of normal emotions, the extension of frustration reactions into bizarre stereotyped responses or regressive behavior, and the compounding of the confused thinking of the ordinary individual who has experienced deep shock or emotional disaster. Psychotic behavior involves a general disorganization of the individual's emotional make-up, sensory and motor disturbances, and usually disturbance and deterioration of intellectual

activities. Three general types are usually distinguished: the affective disorders, schizophrenia, and the relatively rare "true" paranoia. In actual practice it is often difficult to make a positive diagnosis, as many psychotics exhibit mixed behavioral symptoms.

Affective disorders. The affective psychoses are characterized by extremes in mood, often appearing similar to variations experienced by all of us. A *manic-depressive* psychotic displays at one time extreme elation and hyperactivity and at another, extreme depression or melancholy. These individuals may swing from one mood to the other at regular or irregular intervals. In some cases the shift is gradual, while others may show sudden drastic changes from one extreme to the other. In his hyperactive moods, the manic tends to become quite uninhibited and irresponsible. Although he pursues a task with great energy, he is quite likely to leave it unfinished to take up a new task with equal vigor. His uninhibited social behavior makes social adjustments almost impossible. As a dramatic contrast, the same person in a depressed state becomes sad and listless, often expresses feelings of worthlessness and guilt, and sometimes attempts suicide.

The psychosis known as *involutional melancholia* is a severe depressive reaction which occurs at the "involutional" period of life, that time in the life of an adult when he realizes that his physical and psychological powers are waning. It has sometimes been thought that women are particularly susceptible to this disorder during the menopause, and that it might properly be considered an organic disorder. We now realize that both men and women show this type of psychosis, and that there is no clear-cut evidence that it is organic in origin. In the past, involutional melancholia often lasted until death, but modern methods of treatment have markedly improved the possibilities of readjustment.

Schizophrenia. Schizophrenia is the most frequent of the major psychoses, accounting for about 20 percent of all patients admitted to mental hospitals. Since these patients often remain in hospitals for long periods, they may account for almost half the hospitalized psychiatric cases at any given time. The term schizophrenia implies the splitting off of the personality from its surroundings, but it is not to be confused with the splitting of the personality as described for dissociation in neurosis. The schizophrenic withdraws from reality as others know it, displaying an almost complete breakdown of social interactions, a blunting of the emotions, and an extreme introversion in thinking and action. Four general reaction patterns which are observed in schizophrenia are shown in Figure 17.7.

The *simple schizophrenic* can sometimes make a borderline adjustment to the external world, but his listlessness and preoccupation interfere with his holding a responsible or creative position. These individuals sometimes support themselves by performing simple tasks or becoming vagrants, prostitutes, or criminals. Usually they are not hospitalized because they are not dangerous or particularly disturbing to other people. The *hebephrenic* reaction is marked by regression to infantile modes of behavior, by silly giggling, infantile postures, or baby talk. The person may use new words which have no meaning to others, or combine words in unorthodox ways so that his conversation appears

senseless. The hebephrenic's intellectual disorganization can be seen in the confused nature of his delusions and hallucinations. One woman announced that she was a policewoman, an actress, and a man within a five-minute conversation. The person with *catatonic* schizophrenia shows rigid, stereotyped behavior and extreme negativism. As shown in Figure 17.7*c,* he may maintain for hours a difficult posture which would ordinarily be almost impossible after a few minutes. In other cases repetitive movements may be carried out without ceasing for hours at a time. The *paranoid* schizophrenic has delusions of persecution or grandeur, often of a religious or political nature. This is the cartoonist's view of the patient who thinks he is Napoleon. In keeping with his delusions, the paranoid schizophrenic often has exaggerated suspicions and apprehensions of other people, and reacts in hostile and aggressive ways.

Paranoia. The delusions of paranoid schizophrenia are not logically organized. In contrast, the occasional person who is diagnosed as having "true" paranoia has developed a highly systematized and internally logical delusion, but otherwise behaves in a normal manner. Calling him psychotic or normal is essentially a matter of whether or not you believe in his delusions. A man may believe that his wife is trying to kill him and organize his behavior entirely in keeping with his attempts to avoid her. If she is actually trying to kill him, then his reactions are sensible adjustments; if she is not, he is displaying a psychotic delusion.

Theories of Behavior Disorder. Up until the end of the nineteenth century no one seriously questioned the notion that the behavior disorders were disease entities that

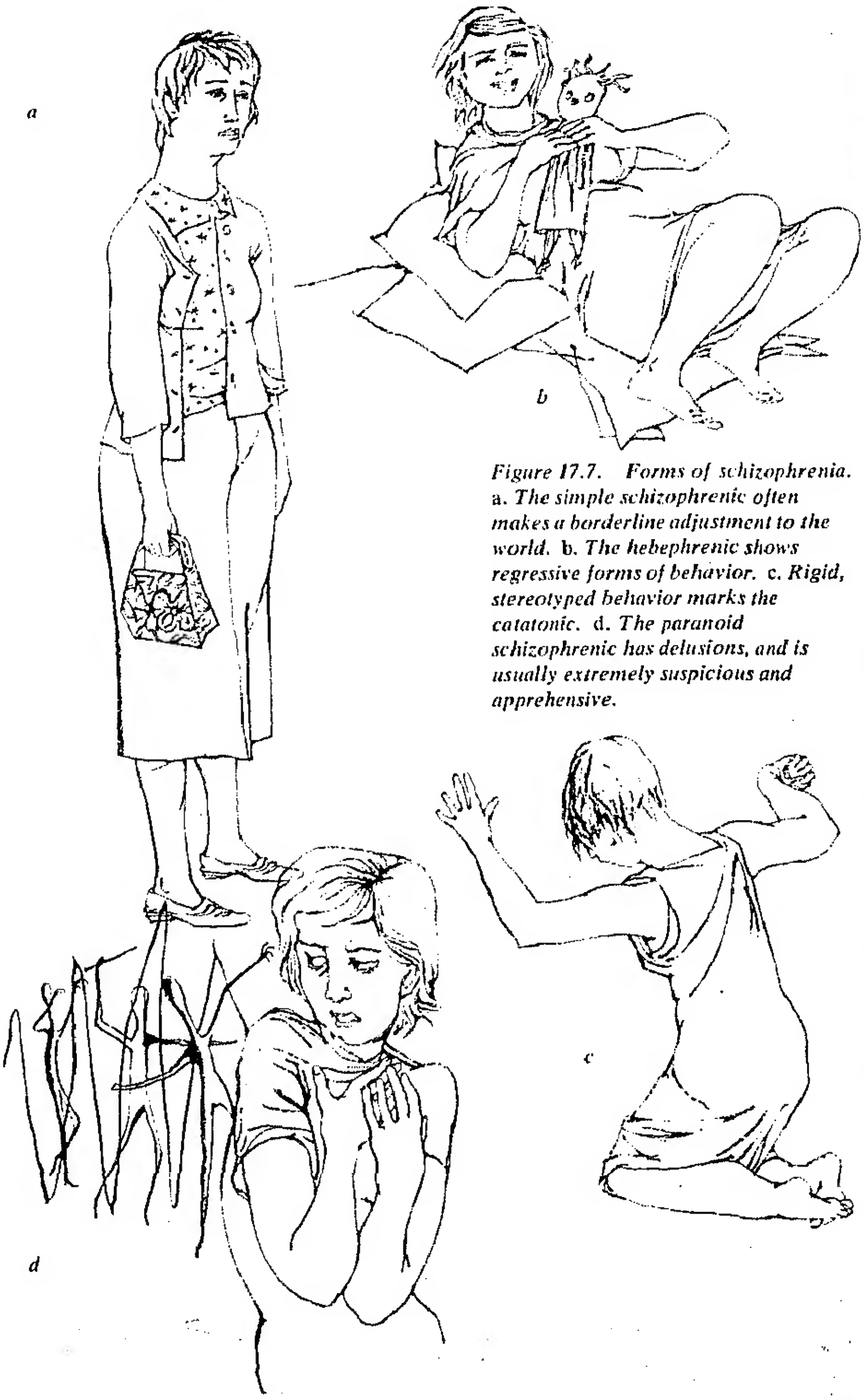


Figure 17.7. Forms of schizophrenia. a. *The simple schizophrenic often makes a borderline adjustment to the world.* b. *The hebephrenic shows regressive forms of behavior.* c. *Rigid, stereotyped behavior marks the catatonic.* d. *The paranoid schizophrenic has delusions, and is usually extremely suspicious and apprehensive.*

found their origin in hereditary defects or some pathological condition of the organism. Our present-day ideas that many of the behavior disorders are functional—that is, that they have their origin in individual experience and learning—were revolutionary when first proposed early in this century. Recently there has been renewed interest in the organic approach to both normal and disordered behavior, as evidenced by many types of research on the regulatory systems of the body.

Any theory of the nature of personality has implications for the origins of personality breakdown. Of the different ideas that we outlined in Chapter 16, Freud's psychoanalytic theory was in fact developed to account for disordered patients and later extended to normal individuals, but there have been no other comprehensive attempts to account for all of the facts of behavior disorder. Other theorists in the field of behavior and personality have applied their concepts to rather limited aspects of behavior disorder. In general, their greatest successes have been in describing the neuroses in terms of reactions to stress and conflict, unconscious symbolism, anxiety reduction, defense mechanisms, and so on. In contrast, there are no satisfactory accounts of the origin and nature of the psychoses. However, since studies and therapy of both neurotic and psychotic behavior are guided by theoretical orientation, we should review the most widely accepted points of view.

All functional theories recognize that disordered reactions can be regarded as learned adaptive responses of the individual. The emphasis of Adolf Meyer, an American psychiatrist, on the organism's unceasing struggle to adapt to his environment is known as the "psychobiological" approach to behavior disorders.[4] Although there is no ready explanation for the extreme behaviors exhibited by psychotics, their confused thinking, stereotyped activities, and withdrawal from social interplay are viewed as being due to the breakdown of established habits in the individual. From this point of view, therapy is directed toward comprehensive physical rehabilitation of the patient, coupled with specific retraining and the bringing of some understanding to the patient of his symptoms.

Another approach to disordered behavior is that it must be viewed in relation to the cultural and social environment in which it occurs. Anthropological studies of various cultural groups have shown that behavior patterns that are considered abnormal in one culture are accepted, and therefore "normal," in another. Furthermore, since there are many variations in the standards of conduct required of members of different societies, it is possible that an individual who could adapt to one type of social environment might be unsuccessful in adapting to another. There have been some efforts to relate frequency of behavior disorders to socio-economic level and other social variables. The results of such studies are suggestive, but not conclusive. However, it is generally believed that the early environment of the child, particularly his home environment, is as important in determining disordered behavior as any other factor. The social emphasis in psychotherapy is toward improving the living environment, social retraining, and teaching skills which may aid social readjustment.

Psychoanalytic theory (see p. 446 ff.) accounts for the behavior disorders, particularly the neuroses, as resulting from

disturbed psychosexual development. The degenerative nature of schizophrenia is attributed to a failure in socialization and in development of the superego. It should be noted that orthodox psychoanalysis is usually not an effective method of dealing with psychotics. Modifications of such procedures for treatment of psychotics have been described, but their full effectiveness over a period of time has yet to be determined.[5]

At the present time these various points of view about behavior disorders are undergoing a general re-evaluation in the light of significant new developments in the field. As we shall learn later in the chapter, the effects of certain drugs on both normal and disturbed behavior are revising our ideas about the origin and nature of some of the serious disorders. The functional psychoses and neuroses appear to resemble the psychosomatic illnesses, with the organic disturbance in these cases affecting chemical processes within the central nervous system. This currently evolving theory can be called the psychohumoral theory of neuroses and psychoses. It postulates that through persisting states of emotional or other bodily disturbance, the chemical mechanisms of the brain are gradually altered, leading to symptomatic behavior characteristic of the disorders. We shall examine these ideas elsewhere.

TREATING NEUROSES AND PSYCHOSES

In past years most of the problems connected with seriously disturbed behavior arose out of the fact that treatment was "too little and too late." With an increased understanding of the behavior disorders among people in general, and with ever-enlarged facilities for handling patients, the trend is toward starting treatment early to prevent, if possible, a complete breakdown in adjustment.

The disturbed person who goes to a modern hospital or diagnostic clinic for help has the benefit of medical, psychological, and social work procedures. After a preliminary interview, he is given a medical examination, including brain wave recordings, his social history is obtained, and psychological tests are administered. Thus the tentative diagnosis of a patient's trouble may be jointly arrived at by a psychiatrist, medical specialists, psychologist, and social worker. At this diagnostic conference, a course of treatment is outlined. If the patient is not too seriously disturbed to communicate readily with others, his treatment may be principally psychological—that is, psychotherapy.

Psychotherapeutic Practices. In crowded hospitals or busy clinics, the course of psychotherapy may be limited by the available time of the therapist or the patient's ability to pay. In such cases psychotherapeutic treatment consists of occasional brief interviews, in which the patient is encouraged to talk about his problems. In many cases the most important effect achieved by brief psychotherapy is *supportive* acceptance of the patient by the counselor (Fig. 17.8*a*). The counselor in effect becomes someone to lean on in an emotional crisis, to give assurance that the patient will be able to work things out. In some cases this friendly listening and emotional support helps the patient gain control of himself and readjust his life. If his personal problem arises out of a social situation that can be altered—by changing

a b c

Figure 17.8. Psychotherapeutic practices. a. *When the time of the therapist is limited, brief psychotherapy is indicated. Here the principal aim is supportive acceptance of the patient by the counselor.* b. *In more prolonged therapy, the objective is for the patient to achieve insight into his own problems.* c. *In hospitals and clinics, group therapy and role playing are effective techniques.*

jobs, for example, or making family readjustments— supportive counseling along with specific suggestions from the counselor may be very effective.

If the patient's trouble originates in some deep-seated conflict that is not readily apparent, psychotherapy may be of little use unless it can be continued for some period of time. In this case, the principal objective of treatment is for the patient to achieve *insight* into his own problems and modes of conduct (Fig. 17.8*b*). A directive therapist tries to hasten this objective by the nature of his questions and by interpreting to the patient the meaning of his behavior. Here the therapist is guided by his own theoretical orientation. If he is a Freudian, he tries to discover significant relationships between early biological development and the process of socialization. The psychoanalytic approach is to try to help the patient resolve an old conflict by bringing it into consciousness and "reliving" it during the interviews until it no longer is a source of anxiety. The psychobiological approach is to help the patient understand how his troubled behavior developed, but to dwell less on past events than on effective procedures for present readjustment.

According to nondirective therapists, the patient himself can achieve more profound insights into his own troubles than anyone else. Thus the therapist's role is not to offer specific suggestions or interpretations, but to listen sympathetically and to "reflect" the patient's emotional feelings while he works out his own understanding and solution.

An effective technique that is being used more and more in our hospitals and clinics is that of *group therapy*, either group discussion or role playing (Fig. 17.8*c*). We have discussed role playing in Chapter 3, mainly as it is used in training situations. Therapeutic role playing, or *psychodrama*, is very effective with some patients in permitting them to relive painful and unpleasant situations in dramatic form.[6] The audience may be made up of either therapists or patients. In the latter case, these patients benefit from the performance as well as the actor. Figure 17.9 shows some actual instances of group therapy in a hospital setting. In the first photograph, a psychotherapist and a group of patients are planning a session. In the second photograph, a patient is acting out an emotional problem with one of the therapists. One of the principal advantages in group therapy

is the opportunity it gives the patients to acquire social skills. Most of their problems have arisen in a social setting, and in many cases the ability to get along in a social group must be painfully relearned.

Stages in Psychotherapy. Since psychotherapy is essentially a process of communication between the therapist and the patient, its progress depends to some extent on the communicative relationships that are established. First it is necessary to establish *rapport* between the therapist and client (Fig. 17.10*a*). If the client is not able to accept the particular person who is trying to treat him, it is impossible to develop the close interpersonal relationship necessary for progress, and the client will often find some reason for discontinuing treatment.

The second phase is typically one of *release,* when the patient becomes able to talk out his troubles and pent-up feelings of guilt, shame, or hostility (Fig. 17.10*b*). In dealing with children, release therapy is often a matter of permitting the child to give expression to his hostility in relatively uncontrolled or destructive play. Some limits must be set to actual destructiveness, but in a verbal situation, the counselor accepts everything the patient says, no matter how preposterous, with understanding.

During the course of psychotherapy, the patient typically builds up a special emotional attachment to the therapist, either of dependence and love or of antagonism. Often the two attitudes alternate from one session to another. In psychoanalytic terms, this relationship is one of *transference,* in which the patient transfers to the analyst his emotional feelings about persons who have been a part of his emotional conflict situation. Although the psychoanalyst encourages transference and accepts it as a necessary stage in therapy, some psychiatrists try to minimize this personal relationship as much as possible. In any event, before therapy is terminated, it is necessary to reduce this emotional situation as the patient becomes readjusted to other people in his social world (Fig. 17.10*c*).

Improvement shown by a patient during treatment is given several interpretations, again according to the theoretical leanings of the therapist. One way of describing successful therapy is that the patient has achieved a more realistic perception of himself, through release of hostility and guilt. In other terms, the patient reduces his anxiety through learning new habits and effective problem solving, or he discovers and removes conflicts through un-

a

Figure 17.9. The use of role playing in a group therapy situation. When counselors and patients act out problem situations before a group of patients, both the role-playing patients and the audience benefit from the performance. (Courtesy VA Hospital, Tomah, Wis.)

b

a b c

Figure 17.10. Stages in psychotherapy. After the establishment of rapport between the therapist and patient, a, *the second stage is typically one of release, when the patient becomes able to give expression to his pent-up feelings,* b. *A successful termination of therapy involves reducing the emotional dependence of the patient on the therapist, so that he can readjust to the social world,* c.

derstanding and insight. From the patient's point of view, therapy has been a success if he has a feeling of well-being at its termination.

Objective Evaluation of Psychotherapy. It is very difficult to establish accurate data about the success of psychotherapy. When the effects of certain medical treatments on infectious diseases are investigated, it is usually possible to determine whether or not the treatment altered the course of the disease. However, the behavior disorders are not specific diseases, but patterns of behavior. When we ask, following psychotherapy, "Did the patient improve?" it is not always easy to get a valid answer. The patient's report usually cannot be trusted. Often he refuses to admit that there is anything the matter with him until he is beginning to improve. Or, if the therapist probes dangerously close to uncomfortable events in his past, he may be suddenly "cured," and stop his treatments altogether. Nor is the therapist's judgment always valid, for he can become so involved in his patient's progress that he overemphasizes the significance of small improvements.

Barron has suggested five simple changes in the state of the patient as criteria of improvement: (1) the patient feels better, is more comfortable, takes more interest in life, and the like; (2) important current interpersonal relations are straightened out a bit; (3) important health-tending decisions have been made; (4) physical symptoms have been relieved or cured; and (5) there has been an increase in insightful remarks and behavior.[7] In an objective study of the change in 33 adult neurotics after six months of psychotherapy, he based his judgment of improvement on the estimates made by two experts who had had no personal contacts with the cases. Of the 33 patients, 17 were classified as having improved, 16 as unimproved or only slightly improved. Some illustrations of improved cases follow:

1. A depressed, anxious worker, who was submissive but enraged at his foreman, came to be able to express himself, left his job, and started a business of his own.
2. A woman with menstrual difficulties took a more candid view toward her husband and her menstrual difficulties disappeared.

3. A woman who had suffered great trauma in marriage became more at ease, less anxious, and lost many of her phobias.

Lack of improvement could often be described as a failure in interpersonal relationships between therapist and patient. When a patient fails to improve, there is always the question of whether a different therapist might not have done better.

The patients in this study were given various psychological tests, and their test scores compared with the improvement ratings. It was found that the more intelligent the patient, the less serious his trouble at the start of therapy, and the less prejudiced, the more likely he was to show improvement. This third comparison was based on the finding that improvement correlated negatively with ethnocentrism, or racial prejudice. The implication is that the emotional rigidity that is related to prejudice makes emotional readjustment more difficult.

Analysis of Behavior during Psychotherapy. The behavioral aspects of psychotherapy are not immediately available for scientific observation and research. Because of the private, interpersonal nature of the clinical situation, we have to depend for the most part on the therapist's report of what actually occurred. Recently there have been attempts to record different aspects of behavior during therapy in order to identify the critical variables that operate in the situation and to open the way toward more objective evaluations of the different techniques.

Sound-recordings of interviews have made the data of psychotherapy available for repeated study (Fig. 17.11), but interpretations of these data have depended on the development of methods for studying the verbal content in an objective and quantitative way. A number of methods for *content-analysis* have been proposed, by which both the patient's and therapist's verbal responses can be classified.[5] The applications of these systems to the analysis of interview data have so far been inconclusive.

More promising techniques are those which obtain objective measures of the patient's behavior other than the verbal content of his responses. One series of studies attempted to develop measures of the patient's anxiety during interviews based on the expressive aspects of speech rather than its content. The two attributes chosen were speech disturbances and the amount of silence during the interview. Speech disturbances were defined as using "Ah,"

Figure 17.11. Recording the verbal content of psychotherapy. In order to study the psychotherapeutic situation objectively, it is necessary to obtain a permanent record of the patient's verbal responses or other reactions. A permanent verbal record can be analyzed in several ways and by more than one person. (Courtesy VA Hospital, Tomah, Wis.)

Figure 17.12. Analysis of speech disturbances during psychotherapy. The speech-disturbance ratio was computed by dividing the number of disturbances, such as the use of "Ah," repetition, stutter, and so on, by the total number of words spoken. (From Mahl, G. F. Disturbances and silences in the patient's speech in psychotherapy. *J. abnorm. soc. Psychol.*, 1956, **53**, 1-15.)

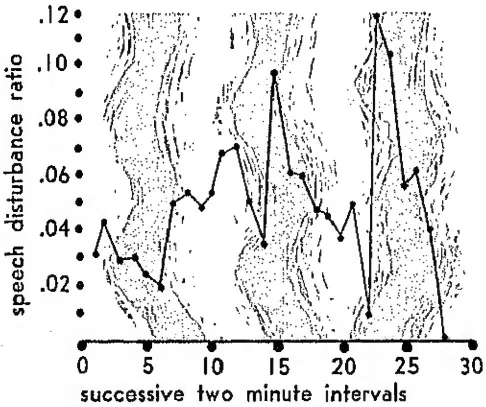
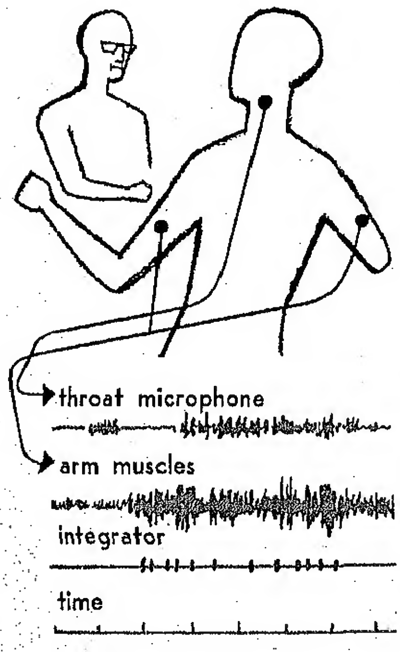


Figure 17.13. Analysis of gestural movements during psychotherapy. The integrator record gave a rough indication of frequency of gestures by summating activity of the arm muscles. The throat microphone recorded the occurrence of speech. (From Sainsbury, P. Gestural movement during psychiatric interview. *Psychosomatic Med.*, 1955, **17**, 458-469.)



sentence correction, sentence incompletion, repetition, stutter, incoherent sound, slip of the tongue, and omission. The number of disturbances divided by the total number of words spoken gave the speech-disturbance ratio. The line graph in Figure 17.12 plots this ratio during successive two-minute intervals of an interview with a woman patient. There was an increase in disturbances during the course of the interview until near the end, when the curve dropped sharply. Although these measures may have been insufficiently validated, the experimenter felt that they differentiated between phases of anxiety and nonanxiety during the interview.

In another study, recordings were made of the heart rate and of muscle potentials from the patient's forearm during interviews. The forearm records were to record gestural movements accompanying speech. In addition, a record of speech activity was obtained from a small microphone attached to the throat. As shown in Figure 17.13, an integrator device summated activity of the arm muscles to mark the occurrence of large gestural movements. During interviews which were planned to include periods when stressful and unstressful topics were discussed, it was found that the heart rate increased and significantly more gestures occurred during the stressful phases. The greatest number of gestures occurred during expressions of resentment.

Although these studies of the behavioral changes during psychotherapy are in their preliminary stages, they bear out our general knowledge of the close interrelationships between verbal and nonverbal communication, and the concurrence of overt and physiological expressions of emotional activity. A refinement of the techniques which can be used to measure patients' responses should enable us to analyze more objectively the course of therapy. In addition, these measures may prove useful in revealing emotional reactions which the patient is trying to conceal.

Shock Therapy. Because of the difficulty or impossibility of communicating with seriously disturbed individuals, psychotherapy is of limited value in their treatment. Very often a psychotic patient in a hospital does not respond to psychological treatment, or if he does, his progress is so slow as to make this procedure of little value. Furthermore, the effect of institutionalization on many patients is to magnify their troubles, and to intensify the individual's deterioration. The aim, therefore, is to get the patient out of the hospital, to return him to an environment which can support him psychologically, and then to treat him on an out-patient basis if possible.

In recent years several drastic treatments have been found effective in alleviating depression and quieting manic states in severe disorders so that the patient may

be amenable to psychological treatment, or in some cases can be released from the hospital. One technique is a form of brain surgery, involving destruction of the nerve fibers connecting the prefrontal lobes with the thalamus, which has the effect of relieving the patient of his severe emotional symptoms. This procedure has been largely discontinued because of the development of other techniques which are less drastic and give better results.

Another treatment for severe disturbances is to induce artificial convulsions by some kind of physiological shock.[9] Following the seizure the patient is in a state of coma for a period of time, after which his symptoms appear less severe. In many cases a series of shock treatments has made psychotherapy possible and paved the way for the patient's return home. An early technique used to produce shock was to administer insulin, which induces a prolonged coma by reducing the blood-sugar level. In the last twenty years, the use of insulin and certain drugs in shock therapy has been replaced for the most part by the technique of *electroshock,* which induces a convulsion by passing an electric current through the brain for a fraction of a second (Fig. 17.14). Electroshock has proved to be particularly effective in alleviating severe depression.

A number of studies have been carried out on both human patients and animals to try to assess the long-term effects of electroshock on psychological functions of the individual. Results are fairly consistent in showing that this method of treatment impairs memory temporarily but apparently does no permanent damage.[10] Despite the rather wide use of this form of therapy, we still do not understand why it acts as it does.

Psychopharmacology. Throughout most of this century, sedative drugs have been used in hospitals to quiet hyperactive patients, but the last decade has seen startling new developments in this field. One line of investigation has been concerned with the induction of emotional reactions and some of the symptoms of behavior disorder by drug action. In addition, a new group of drugs, called tranquilizing agents, have been found to aid greatly in the control of almost all forms of behavior disorders, from behavior problems to the most serious functional psychoses.[11] This general field of research in biochemical-behavioral relations is designated as psychopharmacology.

The tranquilizing drugs—e.g., reserpine, chlorpromazine, and azacyclonol, or Frenquel—were used at first with severely disturbed patients in hospitals. Their effects were dramatic in calming manic states, reducing anxieties, and dispelling hallucinations. Some people who had been hospitalized for years were able to respond to psychotherapy for the first time. In a few years' time, the whole atmosphere of psychiatric hospitals has changed. Whereas not so long ago most psychotic patients were doomed to many years—perhaps a lifetime—of close confinement, many of them strapped into strait jackets, a modern hospital shows groups of patients engaged in social activities, with no restraints in evidence. These striking changes have come about as a result of enlarged professional staffs and the widespread use of shock therapy, but most of all the use of tranquilizers. Recently the mental hospitals were able to report more discharges than admissions over a period of time, surely a milestone in the history of the behavior disorders.[12]

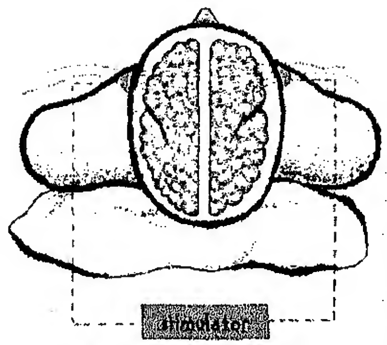


Figure 17.14. Technique of electroshock therapy. By means of electrodes attached to a patient's head, an electric current is passed through the brain for a fraction of a second. This stimulation produces a convulsion, followed by a comatose period.

During the last few years, tranquilizing drugs have been sold under a number of brand names, and their use has been extended to the treatment of conditions of anxiety and tension in persons who continue their everyday work. Although it is too early to assess their significance completely, the general opinion is that these drugs are effective in controlling emotional symptoms, thus making the individual more able to cope with his problems. It is not believed that they constitute a "cure," either for serious or mild disorders, but they reduce emotional disturbance to the point where a course of readjustment is possible. They are also used as a preventive treatment with disturbed children or individuals who have suffered a great emotional shock. Doctors who have prescribed tranquilizers to people facing temporary crises believe that in some cases more severe disturbances quite possibly have been averted.

To understand how the tranquilizing drugs act in the body to relieve emotional symptoms, we have to review what we know about opposing chemical messengers in the nervous system. In Chapter 7 we described the effects of adrenalin in emotional reactions as being due to its inhibitory effect on synaptic connections. The immediate result of an emotional situation is an excess of activity brought about by the inhibition of communication in the nervous system, thus diminishing the normal control exerted by the cerebral cortex. After this immediate activation pattern, the accumulation of more adrenalin acts as a general depressant. The brain hormone serotonin, it will be remembered, is chemically similar to adrenalin and has similar inhibitory effects. Opposing the effects of these chemicals in the normal body is the substance acetylcholine, which *facilitates* synaptic transmission.

Recent work has indicated that symptoms of the behavior disorders can be traced to a disturbance of the mechanisms that ordinarily maintain a proper balance between the two types of chemical messengers. Hallucinations, anxiety, depression, and other effects occur when there is an abnormal accumulation of the inhibitory substances, adrenalin, serotonin, or one of a number of related chemicals which are not normally found in the body. For example, large doses of alcohol or benzedrine produce some of these effects. Two more powerful inhibitors, lysergic acid (LSD-25) and mescaline, are used to induce psychotic symptoms experimentally. Vivid hallucinations, feelings of depersonalization and instability of the environment, and blurred vision are some of the effects produced by these drugs.[13]

The role of the tranquilizers is to oppose the inhibitors in the nervous system. Not only do they block the effects of lysergic acid and mescaline in experimental situations, but they relieve psychotic symptoms in disturbed individuals. Thus we assume that unusual accumulations of adrenalin, serotonin, or related substances in the body result in abnormal behavioral symptoms, and the tranquilizing drugs relieve the symptoms by their opposing chemical action. We have indicated some of these chemical interactions in Figure 17.15. Here we show the hormone serotonin, which is normally found in the brain, being facilitated by lysergic acid to produce experimental psychosis and blocked by the tranquilizers to relieve the symptoms.

Our evaluation of the tranquilizers as therapeutic agents can be only tentative at this time. It is very natural to greet

their initial successes with overenthusiasm, even to believe that here at last are miracle pills that will cure mental illness. However, when we look at the actual results with more restraint, we realize that, although the tranquilizers may get patients out of hospitals, they do not necessarily transform these people into well-adjusted individuals. Furthermore, their use is limited by unpleasant or dangerous side-effects in some people, such as circulatory disorders, tremors, dermatitis, and jaundice. As we get more complete data on their long-term use, we may discover still further disadvantages. Nevertheless the tranquilizing drugs are a great boon to the disturbed individual. Although they do not obviate the need for psychotherapy, they have transformed the psychiatric hospital into a place in which psychotherapy and related procedures of social and occupational training can be used more effectively.

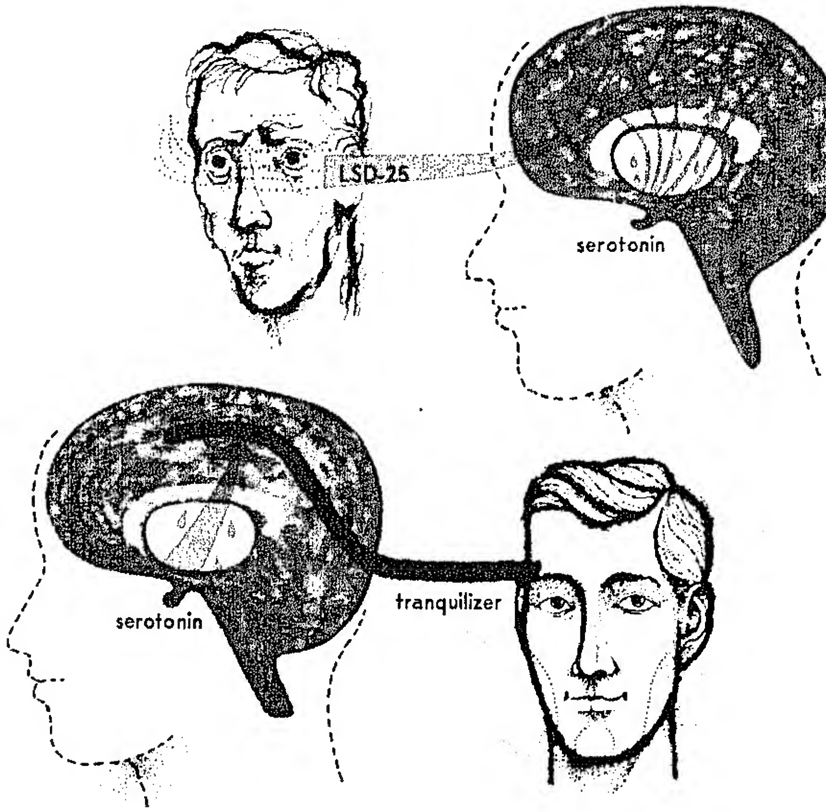


Figure 17.15. Some chemical relations in the production and alleviation of disturbed behavior. Psychotic symptoms can be produced experimentally by LSD-25, which acts similarly to serotonin in inhibiting synaptic transmission. The tranquilizing drugs relieve emotional symptoms by blocking the action of the inhibitors. [Himwich, H. E., The new psychiatric drugs. *Sci. Amer.*, 1955, **193**, (4), 80-86; Marrazzi, A. S., Messengers of the nervous system. *Sci. Amer.*, 1957, **196**, (2), 86–94.]

UNDERSTANDING THE INDIVIDUAL

The recent advances in the field of behavior disorders are as important to the general science of behavior as they are to the applied field of therapy. The relationships that are being established between chemical and neural variables and disturbed behavior are filling in some of the details in our knowledge of the regulatory mechanisms of behavior, as we described them in Chapter 4. Some of the most exciting current research is being done on the relations between the chemical states in the brain and behavior. The neurohumoral regulation of level of activity and emotional states applies not only to ordinary behavior but to the patterns of behavior breakdown.

As it becomes clear that the behavior disorders are related to variations in the chemical balances within the brain, it is tempting to conclude that we have found the organic basis for these disorders, and therefore can depend on chemical therapy for their cure. Unfortunately, rearranging behavior patterns is rarely that simple. We must remember that we do not understand as yet why certain individuals develop the unusual chemical balances that underlie disordered behavior. Knowing what we do about psychosomatic symptoms, those physiological effects of prolonged emotional disturbance, we might suspect that brain chemistry can be changed as a result

of emotional activity just as the other physiological systems of the body can be. If this is the case, then the functional disorders have their origin in the behavioral history of the individual, as most psychologists have believed for many years.

In still another sense, disordered behavior depends on individual learning. While *general* emotional states and *general* levels of excitability seem to be regulated by neurohumoral mechanisms, the specific manifestations of these states in behavior must depend on the developmental background of the individual. The hallucinations and delusions of the paranoid and the behavior patterns of the hebephrenic are responses that a particular person makes in a particular external and internal environment. Thus each new problem in disordered behavior is different from every other one. The study of the behavior disorders is an empirical science, in which each troubled individual must be studied in turn, and understood in terms of his own developmental make-up.

In psychology, as in our everyday dealings with other people, our understanding of the individual is always less than perfect. Although psychology has made great progress in understanding behavior in general—in that never-never land of science where determining factors can be defined and variables can be controlled—it can never completely understand, or predict, or control the behavior of one specific person. This is not to say that we should abandon our scientific search. Quite the contrary. The more a good therapist knows about the generalities of behavior, the more successfully can he deal with behavior in the individual. Yet each person remains something of a mystery, and the one who has the best opportunities for fathoming that mystery is the individual himself.

The techniques of nondirective therapy are founded on the belief that the best vantage point for understanding behavior is from the internal frame of reference of the individual himself.[14] Our perceptions, emotions, thoughts, and needs are very personal forms of behavior, which have no exact counterparts in other people.

The lesson we should learn from the field of psychotherapy is that if a troubled individual can come to understand his own behavior clearly and objectively, he usually has it within himself to work out constructive patterns of adjustment. The problem, from the point of view of the individual, is *in understanding one's self, one's own personality, and the factors that define it.*

To each of us the awareness of self develops from our earliest years and changes as we add new experiences and knowledge throughout our lives, but in some of us this self-knowledge is more complete and objective than in others. All of the evidence from psychotherapy, as well as other studies of behavior, indicates that an individual's understanding of his own modes of adjustment depends on objective knowledge, based on his ability to perceive and to communicate with other people. The responses of an individual have no meaning in and of themselves, but only in comparison with how other people respond, and when judged by the standards of society. Thus an understanding of self implies the ability to make comparisons between one's self and others, arrived at through social perception and communication. Human behavior is social behavior, and if we are to succeed at it, we must learn and constantly practice our social skills.

It is not in the nature of the living system to allow the "self" which inhabits it

to know the millions of events which occur within it at any given moment. The term "unconscious," at best an ambiguity, might be applied to the great array of physical, chemical, neural, and muscular processes which go on in behavior unknown to the individual. For a real understanding of self, we need objective training in the bodily processes of behavior. The more we know about the dynamic interactions of the body in motivation and emotion, in conflict and frustration, in thought and action, the more hope we have of integrating these aspects of our personality into satisfactory modes of adjustment.

The individual's understanding of his own behavior is not in terms of a series of disconnected events, but as an integrated, unified whole. This perceptual unity of self is not an artifact, but reflects the unity of the behaving organism. In our study of psychology we have tried to describe some of the relationships that exist in learning, perception, emotion, motivation, and so on, but in no instance have we been able to describe one aspect of behavior without taking into consideration its other dimensions. The processes of behavior are interactions which define both specific responses and the life pattern. As we learn more and more about the interplay between behavior and neural process, between behavior and body chemistry, and between the various specific phases of response in these interactions, we may gain some real insight into the nature of man and the factors defining the evolution of human society.

SUMMARY

Psychotherapy means treatment by psychological means. It is used, along with other techniques, to help alleviate behavior disorders.

Organic behavior disorders are problems in adjustment that can be traced to known organic conditions. There is no known structural basis for the functional disorders, which include psychosomatic disorders, behavior problems, neuroses, and psychoses. The functional disorders arise through learning and are not sharply distinguished in terms of symptoms. Disturbed behavior is quantitatively different, but not qualitatively different, from normal behavior.

The behavior problems include specific disturbed reactions—such as stuttering, tics, and so on—antisocial behavior, sexual aberrations, and isolation reactions, including alcoholism and drug addiction. Their treatment should include training in physical and social skills.

Some of the reaction patterns of neurosis are diffuse anxiety, depression, obsession and compulsion, phobia, hysteria, and dissociation. Neurotic behavior is characterized by anxiety and emotionally disturbed behavior. Many neurotic responses are evolved to help the individual avoid his problems.

Three general types of functional psychosis are distinguished: the affective disorders, schizophrenia, and "true" paranoia. Schizophrenia is the most frequent. The schizophrenic withdraws from reality, shows an emotional flatness, and extreme introversion.

Treatment of serious disorders may be principally psychotherapy, if the patient is not too seriously disturbed to communicate readily with others. This typically proceeds through the stages of establishing rapport, transference of feelings of the patient to the therapist, and termination of

such transference as the patient improves.

Methods of analyzing behavior during psychotherapy include verbal content-analysis, measures of expressive aspects of speech, and recording gestures and heart rate.

Seriously disturbed patients are often made amenable to psychotherapy by shock therapy and tranquilizing drugs. The tranquilizers apparently work by opposing the inhibitors in the nervous system—adrenalin, serotonin, and related substances. Thus they reduce the effects of emotional disturbance.

The painting below was made by a hospitalized psychiatric patient. The work shows a high degree of perceptual organization of the environment and a sensitive artistic talent.

Glossary

The glossary defines the more important technical words and phrases, as well as common words and phrases with special psychological meanings, as they are used in this book. For more complete coverage of terms and usages, consult the *Dictionary of Psychology* edited by H. C. Warren. Other reference works are *Encyclopedia of Psychology*, edited by P. L. Harriman, and *A Dictionary of Psychology*, by J. Drever.

ability. Skill or knowledge observable in present performance. Contrasted with capacity or aptitude.

abscissa. The horizontal axis of a graph.

absolute threshold. The minimal or maximal intensity or frequency at which a stimulus can be perceived or elicits a specific response. Sometimes called a terminal threshold.

abstract symbol. A symbol that stands for a whole class of events which have some common feature.

abstractive integration. The process of integrating the abstract symbols of past experiences to short-cut problem solving and learning, as in thinking.

accommodation. The adjustment of the lens of the eye to maintain proper optical focus for a given distance of observation.

achievement test. A test designed to measure a person's level of achievement in a particular skill or field of knowledge, i.e., his present abilities.

achromatic colors. Colors without hue; black, white, and gray.

achromatic threshold. The absolute threshold for light intensity. The threshold of sensitivity of the visual rod system.

achromatism. Total color blindness; the inability to discriminate hue.

activity motivation. The drive to be active with no other goal than the activity itself.

adaptation. *With reference to perception,* the change in sensitivity with continued stimulation; e.g., selective adaptation in smell.

additive mixture. The mixture of lights, in which the resulting perceived color is due to the combined patterns of energy. *Cf.* subtractive mixture.

adequate stimulus. Physical energy for which a particular receptor has the lowest threshold; e.g., light for the eye.

adjustment. The patterns of responses or the course of behavior by which an individual adapts to the internal, external, and social environment.

adolescence. The period of life beginning at puberty and extending to the beginning of maturity, i.e., about twenty years of age.

adrenal glands. A pair of ductless glands composed of an inner core, the medulla, and an outer shell, the cortex, which produce the hormones adrenalin and cortin.

adrenalin. A hormone secreted by the medulla (core) of the adrenal gland, producing the same general effects as action of the sympathetic nervous system. *See* nor-adrenalin.

aerial perspective. The blurring of objects in the background and changes in color in distant landscapes due to atmospheric impurities; a factor in depth perception.

affective disorder. Psychosis characterized chiefly by extremes in mood and emotional derangement; e.g., manic-depressive psychosis.

afferent nerves. Those peripheral nerves which carry impulses from receptors to the central nervous system. Also called sensory nerves.

after-image. A persisting perception of a stimulus pattern after it has been withdrawn. The characteristics of a positive after-image are the same as the inducing or original stimulus. The characteristics of a negative after-image are opposite to those of its original stimulus; e.g., the negative after-image of red is green. *See* successive contrast.

all-or-none principle. Applied to muscles, it means that an individual muscle cell, if it responds at all, will respond or contract to its maximum extent. Applied to nerve function, it means that a neuron, if it produces an impulse at all, will respond with the maximum possible energy at any given time.

alpha waves. One of the various kinds of brain waves, having a frequency of about ten per second, and typically observed in states of relaxation or sleep.

amnesia. Partial or complete inability to remember, usually of a temporary nature. Produced by trauma of physical injury or emotional stress.

anal stage. *In psychoanalytic theory,* a stage of development in which gratification and pleasure are centered on the anus and the act of defecation.

androgens. A complex of sex hormones secreted by the male sex glands, responsible for secondary sex characteristics, such as growth of body hair, change of voice, etc., and in part for sexual behavior.

anisotropy. The dependence of figure formation upon lines of direction in visual patterns.

anomalous trichromatism. Weakness in the discrimination of hues. All hues can be perceived, but not in their normal relationships.

antagonistic muscles. Pairs of opposing muscles. By means of reciprocal innervation, when one muscle contracts, the other relaxes.

anxiety. A state of sustained fear and apprehension not directed toward a specific object or situation.

aperiodic reinforcement. A form of partial reinforcement in which the learner is reinforced irregularly in terms of time and number of responses.

apparent movement. Movement perceived although there is no continuous displacement of the stimulus pattern across the sensory surface. *See* phi phenomenon.

approach gradient. An increasing tendency to respond to an attracting object or event as it gets nearer in time or space.

aptitude. The potential ability to learn readily and profit from training with respect to a particular skill or task.

aptitude test. A test designed to measure potential abilities.

area of hearing. A graphic representation of the range of audible sounds between lower absolute thresholds for all sound frequencies and the upper absolute thresholds or thresholds of "feeling" for all frequencies.

Army General Classification Test (AGCT). A group paper and pencil test of intelligence used by the U.S. Army in World War II.

articulation test. A procedure for measuring how effectively speech is perceived under different conditions.

association neuron. A neuron of the central nervous system which makes connections between other neurons.

association time. Verbal reaction time.

asthenic type. One of Kretschmer's body types; tall, thin, with long extremities. Allegedly that body type associated with schizophrenia or the schizoid personality.

athletic type. One of Kretschmer's body types; the well-proportioned individual.

attention. The active, selective aspect of perception, including the orientation and preparation to observe a specific stimulus feature or pattern.

attitude. Learned pattern of symbolic responses directed toward objects, persons, or situations.

attitude scaling. Procedures for measuring attitudes whereby a series of statements or expressions of belief are assigned quantitative values in terms of intensity and direction.

audibility curve. A graph representing the lower threshold of hearing at different frequencies.

audiometer. A device for presenting sounds of different frequencies and intensities to test hearing.

autistic thinking. Thinking which is controlled almost exclusively by emotions and needs and which has little direct reference to the external environment.

autonomic nervous system. That part of the nervous system controlling endocrine glands and smooth muscles. Its action is involved in emotional behavior of all kinds and in homeostatic mechanisms.

avoidance gradient. An increasing tendency to avoid an object or event as it gets nearer in time or space.

Babinski reflex. Extension and fanning of the toes elicited by stroking the sole of the foot. A normal reflex in infants.

backward conditioning. A form of classical conditioning wherein the unconditioned stimulus is presented prior to the conditioned stimulus.

basal age. A measure derived from the Stanford-Binet intelligence test; the highest age level at which every test for that age is passed.

basilar membrane. The membrane in the cochlea on which are located the auditory receptors.

behavior. Responses of an organism to changes in its environment.

behavior disorder. Any persistent disturbance or limitation of behavior which prevents an individual from fulfilling a satisfying role in society.

behavior problem. A limited disturbance in adjustment; e.g., stuttering, alcoholism.

behaviorism. A system of psychology which rejects the concepts of consciousness and experience, proposing that psychology can deal only with the events of observable behavior. Its origin is associated with J. B. Watson. Contrasts with introspectionism and gestalt psychology.

bilateral transfer. Transfer of training between symmetrical parts of the body; e.g., right hand to left hand.

bimodal distribution. A distribution having two points of high frequency, i.e., two modes.

binocular disparity. The difference between the two retinal images which is the basis of normal stereoscopic vision.

blind spot. A small area of the visual field of each eye in which nothing can be seen, due to the absence of receptors in the retina at the point where the optic fibers converge to form the optic nerve. The blind spots of the two eyes do not overlap.

brain waves. The electrical activity of the brain as recorded by an electroencephalograph. *See* alpha waves.

breath group. Unit of speech defined by a movement of expiration of the abdominal muscles.

brightness. The psychological intensity of a visual stimulus. Related most directly to physical intensity. Sometimes called brilliance.

case history. A detailed record of an individual's past life used for the purpose of better understanding present behavior and facilitating future adjustment.

centile score. A percentile score.

central nervous system. The spinal cord and the brain.

central tendency. A single value which can be used to represent a distribution of measures. *See* mean, median, mode.

central theory of thought. The theory that thinking is a function of the brain, essentially independent of peripheral sensory and motor events.

cerebellum. A part of the brain located just below the posterior part of the cerebral cortex. Its primary func-

tion is the timing and coordination of body movements.

cerebral cortex. The folded covering of the forebrain.

cerebral hemispheres. The two major brain masses joined by the corpus callosum. Together they are known as the cerebrum.

cerebrotonic. A kind of personality or temperament characterized by asociability, nonadventurousness, and hypersensitivity. According to Sheldon, correlated with ectomorphy.

cerebrum. The two cerebral hemispheres.

chemoreceptors. Receptors of taste, smell, and those in certain mucous membranes whose adequate stimuli are chemicals in some form.

childhood. The period of life from the age of two years to the onset of puberty.

chromatic colors. Colors characterized by hue; e.g., red, green, blue.

chromatic threshold. The intensity value of a chromatic stimulus at which its hue can be perceived. The threshold of sensitivity of the visual cone system. *See* absolute threshold.

chromatic vision. Perception of hues.

chromosomes. Particles within the nucleus of a cell containing the genes, the primary determinants of heredity.

chronological age (C.A.). Age calculated from birth.

ciliary muscles. Tiny muscles which control the shape of the lens of the eye.

classical conditioning. The learning situation in which a conditioned stimulus, after being paired a number of times with an unconditioned stimulus, finally produces by itself a response (conditioned) similar to that originally given to the unconditioned stimulus.

client-centered therapy. Nondirective therapy.

clinical method. A general name for numerous techniques used to study an individual's behavior in a therapeutic setting.

clinical psychology. A field concerned with diagnosis, therapy, and research in behavior disorders.

closure. As applied to perception, a gestalt principle stating that any stimulus pattern, no matter how incomplete, will tend to be perceived as an organized, stable whole.

cochlea. The bony, snail-shaped cavity of the inner ear which contains the auditory receptors with their associated structures.

coefficient of correlation. The quantitative index of correlation ranging from -1.00 through 0.00 to $+1.00$. Symbolized by the letter *r*. *See* correlation.

cognitive theory. A learning theory which states that acquisition involves the perceiving of relationships among stimuli or stimulus patterns and is not dependent upon reinforcement.

color blindness. Deficiency in the discrimination of all or some hues.

color induction. Color effects produced by the intrinsic properties of the visual system; e.g., simultaneous or successive contrast.

color mixture. The admixture of two or more colors to produce a different color effect. *See* additive mixture, subtractive mixture.

color solid. A representation in three dimensions of the universe of color. The vertical axis stands for black-white variation, the periphery represents the different hue values, and the axis from the center to the periphery stands for variations in saturation.

color zones. Areas of the retina, and hence of the visual field, in which particular colors can be seen.

colorimetric purity. The proportion of the dominant wavelength in a light sample relative to the amount of white light present.

common chemical receptors. Receptors in certain mucous membranes of the body which are sensitive to various chemicals.

comparative psychology. The comparative study of animal behavior.

compensation. A substitute reaction of frustration in which an individual "makes up" for a deficiency by adopting a different but successful mode of response.

complementary hues. Two hues which when mixed in proper proportion produce gray.

compulsion. An irresistible act with no apparent meaning which a person performs as a defense against anxiety. Often ritualistic in nature.

concept. The symbolic representation of a characteristic common to a whole class of objects, people, or events.

conditioned response. The response acquired in relation to the conditioned stimulus in classical conditioning or *operant learning*.

conditioned stimulus. The stimulus in conditioning which, when paired with the unconditioned stimulus, finally arouses a response similar to the unconditioned response.

conditioning. The procedure by means of which a conditioned response is acquired.

cone. One of the two types of visual receptors, so named because of its shape. Cones are sensitive to differences in hue and have a higher absolute threshold than the rods.

conflict. A condition produced by incompatible forms of motivation. Approach-approach, approach-avoidance, and avoidance-avoidance are the three basic kinds of conflict.

content analysis. A procedure for classifying and analyzing verbal material in order to identify significant psychological variables.

contiguity theory. A learning theory which states that stimuli present at the time a response is made will tend to evoke the same response when they recur, regardless of the factor of reinforcement.

control group. A group of subjects alike in all significant respects to the experimental group except that the con-

trol group is not subjected to the independent variable in an experiment.

convergence. The horizontal turning in of the eyes to maintain fixation on a given point in space.

cornea. The outer transparent part of the eye in front of the iris and lens.

corpus callosum. The thick band of neural fibers which connects the two cerebral hemispheres.

correlation. A statistical procedure for determining the degree of relationship between two variables. *See* coefficient of correlation.

cortin. A complex of hormones secreted by the adrenal cortex.

co-twin control. A method of holding the factor of heredity constant by using identical twins as subjects. One of the twins is the experimental subject while the other serves as the control subject.

counseling. Procedures of aiding people in solving personal problems through giving advice, using psychological tests, and providing information.

criterion. Applied to psychological tests, any standard against which a test is validated.

cross-validation. A procedure for rechecking the validity of a test or method of measurement. Test scores or measures from a second sample, similar to the original standardization sample, are correlated with the criterion measure.

culture. An inclusive term standing for all of the practices, general beliefs, tools, language, and standards of a particular people.

cutaneous receptors. Receptors in the skin which subserve the perception of cold, warmth, pressure, pain, etc.

cutting score. A score designating the test performance above which is acceptable performance and below which is not acceptable.

cycloid. A personality "type" described as friendly, lively, and alternately depressed and elated. Resembling manic-depressive psychosis, and allegedly associated with pyknic body type. (Kretschmer.)

dark adaptation. Progressively increased sensitivity of the visual receptors in the absence of light stimulation.

decibel. A relative measure of sound intensity or loudness. One tenth of a bel. It is the ratio between a sound of a given intensity and a reference sound.

delayed reaction. A form of response in which a delay period is introduced between the presentation of test stimuli and the giving of the response.

delusion. An unjustified and irrational belief, conclusion, or judgment symptomatic of paranoid states.

dependent variable. The factor in an experiment, such as observed behavior, which changes as the independent variable changes or is varied by the experimenter.

depression. A state of reduced activity, accompanied by feelings of hopelessness and unworthiness. In severe form indicative of a psychotic state.

deuteranopia. The common form of red-green blindness in which reds and greens are seen as grays.

development. The differentiation of body structures and functions.

deviation I. Q. An index of intelligence derived from the Wechsler test, which is determined by how much a person deviates from the mean test performance of his age group.

dichromatism. The common form of color blindness in which the individual can match all hues with mixtures of two primary hues.

difference threshold. The smallest discriminable difference between two stimulus values. *See* just noticeable difference.

differential psychology. A general field of psychology concerned with differences among individuals and groups.

differentiation. In learning, progressive reduction of generalization due to selective reinforcement.

differentiation theory. The theory that language (or other behavior) develops by the progressive differentiation of finer responses out of more general patterns.

discrimination. Perceiving or reacting to stimulus differences.

discrimination reaction time. The time required to make a specific response to one of two or more stimuli simultaneously presented.

displaced aggression. Also called displacement. Aggressive behavior directed toward an object or situation different from that producing the original frustration.

dissociation. A type of hysterical reaction in which normally associated behavior patterns function independently. In an extreme case, a person may develop two or more relatively distinct personalities which are expressed alternately.

distributed practice. Practice in which trials or groups of trials within the total learning period are separated in time. *Cf.* massed practice.

disuse hypothesis. A theory of forgetting which assumes that learning is based upon some kind of neural change which degenerates if the learned behavior is not used. Forgetting is presumed to be due to the degenerative changes.

double alternation. A pattern of alternate responses in which each response is repeated once, such as turning right, right, left, left. *See* temporal maze.

drive. A demand or condition of the organism which compels it to behave. Sometimes distinguished from motive because the goal or incentive is not specific.

drive reduction. The lowering of tension or a tension state related to a particular drive.

duplexity theory. The theory of vision which maintains that vision is a dual system, one part of which subserves chromatic vision (the cones) and the other, achromatic vision (the rods). Sometimes called the duplicity theory.

dysplastic type. A miscellaneous body "type" defined by Kretschmer, including those persons who do not fit either the pyknic, asthenic, or athletic type, such as malformed individuals.

ectomorphy. A component of body build or somatotype, characterized chiefly by linearity of structure and predominance of skin and nervous tissue. (Sheldon.) *See* somatotype.

effector. A responding organ; a muscle or gland.

efferent nerves. Those peripheral nerves which carry impulses from the central nervous system to muscles and glands. Also called motor nerves.

ego. In psychoanalytic theory, the level of personality through which the id interacts with the social and physical environment. The ego restrains and channels the id impulses.

eidetic imagery. Extremely accurate memory in which recall is nearly equivalent to the original perception. Said to be more frequent in children than in adults.

electroencephalograph. An electronic instrument used to record the electrical activity of the brain in the form of electroencephalograms, or "brain waves."

electroneural conditioning. Operant conditioning or learning based upon direct electrical stimulation of certain parts of the brain.

electroshock therapy. A treatment for psychosis in which a brief electric current is passed through the brain by means of electrodes attached to the head.

emotion. That aspect of behavior related to variations in excitement and relaxation, with their associated expressive movements and attitudes.

emotional habit patterns. Patterns of learned emotional behavior based on the effects of immediate emotional reactions plus their after-effects; e.g., the habit patterns of frustration.

encephalization. Progressive increase in the size and importance of the forebrain during the course of evolution.

endocrine system. The interrelated system of hormone-producing glands which empty directly into the blood stream.

endomorphy. A component or dimension of body build or somatotype, characterized chiefly by a predominance of fatty tissue especially in the abdominal area. (Sheldon.) *See* somatotype.

epilepsy. A convulsive disorder thought to be related to brain abnormalities.

esthesiometer. An adjustable two-pointed device for stimulating the skin in order to measure cutaneous sensitivity in terms of a two-point limen.

estrogen. A complex of female sex hormones produced by the ovaries, causing growth changes in the uterus, vagina, and breasts, and affecting the hormonal secretions of the pituitary.

estrus. Sexual receptivity of the female animal when hormones are released into the bloodstream at the time of ovulation.

ethnic group. A "racial" or national group.

experimental group. The group in an experiment which is subjected to the effects of the independent variable. *See* control group.

experimental method. The basic method of science in which different factors related to an event are controlled and their relation to this event or variable observed and measured.

extensional meaning. Meaning derived from behavior; behavioral meaning.

external environment. The complex of stimuli outside the body.

exteroceptor. A receptor responsive to stimuli coming from the external environment; e.g., the rods and cones of the eye.

extinction. The reduction in strength or frequency of a response as a result of repetition without reinforcement.

extrasensory perception (ESP). A term used to stand for perception and thought supposedly mediated by other than sensory mechanisms; e.g., telepathy, clairvoyance.

face validity. Validity assumed to exist because of the similarity of an item or test to that which it is supposed to measure. A measure may have face validity but not necessarily "true" validity. *See* validity.

factor analysis. A statistical technique used to discover the main factors involved in many interrelated measures or variables, such as primary mental abilities.

fantasy. Imaginative or symbolic activity of day and night dreaming.

feeblemindedness. Intellectual retardation in individuals with I. Q.'s of about 70 and below.

feedback. Information given by a responding system about its own action; sensory feedback.

fetal motor sequence. The period of prenatal growth and development from about the eighth to the fifteenth week, in which appear the primary forms of reflex movements.

fetus. A term applied to the developing organism during the fetal period; in the human organism, from about the eighth week after conception to birth.

field-study method. A scientific method involving the objective and systematic observation of behavior in its natural setting without attempting experimental variation or control.

figural after-effects. Changes in figure formation related to the lingering effects of just previous perceptual activity.

figure formation. The process of differentiation of a figure or perceived object from a ground. The basic aspect of perceptual organization.

fixed-interval reinforcement. A form of partial reinforcement in which the learner is reinforced only after fixed intervals of time; e.g., after every minute.

fixed-ratio reinforcement. A form of partial reinforcement in which the learner is reinforced only after he makes a specified number of responses.

follicular hormone. A hormone secreted by the ovaries, related to development of secondary sex characteristics and cyclical changes in behavior in the female.

forgetting. Inability to elicit a learned response after some degree of acquisition has been achieved. *See* extinction.

formal-discipline theory. The traditional doctrine, essentially invalid, which claims that the study of certain basic or core subjects (e.g., Latin) trains one to think better or "trains the mind."

fovea. The central region of the retina stimulated when one looks directly at any object. The density of cones is highest in the fovea and it is also the region of greatest visual acuity.

fraternal twins. Twins produced by the fertilization of two different egg cells at approximately the same time.

free association. Unrestricted reverie; a technique used by psychoanalysts to discover conflict by studying such reveries.

free nerve endings. Proliferated endings of sensory nerves not associated with specialized receptors.

frequency distribution. An arrangement of a set of scores in groups, according to size.

frontal lobes. Those parts of the cerebral cortex anterior to the central fissures.

frustration. A pattern of emotional and disorganized behavior related to conflict or blocking of motivated behavior.

frustration-aggression hypothesis. The theory that aggression is the direct consequence of frustration, and can be displaced to members of out-groups, resulting in prejudice, class warfare, etc.

functional autonomy of motives. A descriptive principle in motivation which states that secondary motives develop through learning by being associated with primary motives, but in time become functionally independent of the latter; not universally accepted.

functional disorder. Any disorder without a known bodily origin; e.g., neurosis. A disorder arising from the pattern of learning and adjustment of the individual.

functional social role. A social role characterized by behavior directed toward fulfilling the needs of a group and its members.

functionalism. A theory or system emphasizing the understanding of psychological events in relation to their functions or the ends that they serve.

galvanic skin response (GSR). A recorded change in the electric resistance of the skin.

ganglion. An aggregation of nerve cells and synapses, located either inside or outside the central nervous system.

generalization. The transfer or extension of a learned response to other stimuli. In thought, the extension of a concept from a specific instance to cover a class of such instances. *See* response generalization, stimulus generalization.

genes. The primary factors of heredity found within the chromosomes. Genes occur in pairs; a dominant gene, if it combines with a recessive gene, will exert its influence in development, masking the influence of the recessive gene.

genetic psychology. The field of psychology which studies the development of behavior from its first appearance in fetal life to maturity. Also called developmental psychology.

genital stage. In psychoanalytic theory, the terminal and adult stage of development in which normal heterosexual adjustment is achieved.

genius. A word with no established technical meaning, but usually defined as an individual with a measured I. Q. of 140 or more.

gestalt psychology. A field of theoretical and experimental psychology which has sought to systematize the principles of figure formation into a general theory of behavior.

glottis. The opening between the vocal cords.

goal. A situation which terminates motivated behavior.

graphology. A system of personality analysis based upon the nature of handwriting and its characteristics.

group dynamics. The organization, operating features, and nature of group activity, or the scientific study of such social phenomena.

group role. A social role consisting of a pattern of activities, such as a job or responsibility, defined by the structure of the group.

group test. Any test designed to be administered to a number of people at the same time; e.g., the AGCT.

group therapy. Psychotherapy in which patients interact socially under the guidance of a therapist. *See* psychodrama.

growth. Physically, the adding of cells or increase in size. Psychologically, the general increase in level or magnitude of ability.

GSR. The galvanic skin response.

hair cells. The receptors for hearing, located on the basilar membrane within the cochlea. Grouped into inner and outer hair cells.

hallucination. A perceptual response which bears little or no relation to observations made by others; e.g., "pink elephants." Under certain circumstances, a symptom of psychosis. To be distinguished from illusion (*q.v.*).

heredity. The organization of the living system both structurally and functionally as defined by genetic transmission from parents to offspring.

histogram. A bar graph or diagram in which the horizontal axis (abscissa) represents the score value or unit of measurement, and the vertical axis (ordinate), the frequency of occurrence of each score or measure.

homeostasis. The tendency of the body to maintain a steady internal state; e.g., constant internal temperature.

hormones. Chemical substances secreted by the ductless glands which help regulate internal bodily processes; e.g., adrenalin.

hue. The visual quality varying most directly with the dominant wavelength of a visual stimulus. Also called chroma, and in ordinary terms, color.

human engineering. A specialized field of applied psychology which studies behavior as it relates to the design, operation, and use of machines and work situations. Sometimes called ergonomics or work science.

Hunter-McCrary law. Irrespective of the general conditions of efficiency for a given kind of serial learning, the relative distribution of errors throughout the sequence remains fairly constant. The percentage of errors is greater in the middle of a sequence and less at the ends.

hypnosis. An induced state of heightened suggestibility.

hypochondriasis. A neurotic reaction pattern characterized by unreasonable concern over physical health, with exaggerated and anxious complaints of illness.

hypomania. A moderate or restricted excitable state or mania.

hypothalamus. A neural center, making up part of the forebrain, which plays a vital role in regulation of activity level, temperature, hunger, thirst, and emotional behavior.

hysteria. A neurotic reaction pattern in which anxiety is reduced and conflict is resolved by conversion into bodily symptoms; e.g., functional paralysis.

id. A Freudian concept referring to the instinctual, biological, and unconscious aspect of personality.

identical twins. Twins produced by the fertilization of a single egg cell, hence two individuals with the same hereditary make-up.

identification. Adoption of modes of behavior characteristic of another person who is admired and respected. A form of compensation.

idiot. A person whose I. Q. is 25 or less, and who is completely dependent on other people for survival.

idiot savant. A person of low general intelligence having a particular skill, usually very specific and not closely related to verbal ability, such as a phenomenal memory, a talent for music or art, or a facility in manipulating numbers.

illusion. A perception which is inconsistent with other forms of perception and measurement of the same stimulating situation.

imbecile. A person with an I. Q. ranging from 26 to 50.

impersonal role. A social role of an interpersonal nature, but which does not involve true social interaction between individuals; e.g., prison guard, prostitute.

implicit response. A subtle or minimal response, usually going on inside the body, hidden from ordinary observation.

imprinting. Very rapid learning of a perceptual nature that occurs in some animals, notably birds, during early developmental stages.

inadequate stimulus. Physical energy which can stimulate a particular receptor system although the system is not especially sensitive to it; e.g., electricity for the eye.

incentive. An object, situation, or event toward which motivated behavior is directed.

independent variable. The factor in an experiment which is systematically changed by the experimenter in order to discover its relation to a dependent variable (e.g., behavior) being observed.

individual test. A test designed to be administered to one individual at a time; e.g., the Stanford-Binet test.

individuation theory. A theory of behavior development which postulates that behavior is first an organized general pattern out of which specific and discrete responses differentiate.

infancy. The period of postnatal development from the ages of one month to two years.

inner ear. The innermost division of the auditory mechanism which contains the cochlea and semicircular canals.

insight. The rapid solution of a problem. In gestalt psychology, the perception of relationships as a basis of learning.

instinct. A descriptive term referring to unlearned patterns of motivated behavior.

integration theory. A theory of behavior development which postulates that complex forms of behavior emerge from the combination and integration of specific and discrete reflexes or responses.

intelligence. The general complex of traits and abilities related to flexibility in adjusting to the social environment. Abilities to learn, to think in abstract terms, to use language, and to perceive complex relationships are typically thought to represent the core of intelligent behavior.

intelligence quotient (I.Q.). The index of intelligence expressed as a ratio of mental age (M.A.) to chronological age (C.A.) times 100. Applicable to individuals whose chronological age is 15 or less. Different procedures are used for older children and adults.

intensional meaning. Meaning which is defined in terms of other words. The dictionary meaning of a word.

interaction. The principle that determining factors interact in such ways that the final effect is not predictable from knowledge of the isolated influence of each factor.

internal environment. The physiological events and conditions existing within our bodies; e.g., chemical conditions, mechanical displacements, temperature.

interoceptor. A receptor responsive to stimuli of the

internal environment, principally in the viscera. Sometimes called organic receptor.

interpersonal role. A social role characterized by direct interaction between two individuals; e.g., parent-child.

introspectionism. A system of psychology followed by the early experimental psychologists, who studied mental activities by the method of introspection, i.e., the subjective analysis of sensations, images, and feelings. These three elements were considered to be the "building blocks" of the mind.

involutional melancholia. An affective disorder marked by extreme depression which occurs at the time of life when physical and psychological powers are waning.

iris. The pigmented diaphragm of the eye which controls the size of the pupil and thus the amount of light admitted to the eye.

item analysis. A procedure for determining whether test items differentiate between groups which are known to differ on some other basis or bases.

job analysis. The systematic study, description, and rating of characteristics and duties of a job along with the abilities, training, and experience required to perform it.

just noticeable difference (j.n.d.). The smallest difference between stimulus values which can be discriminated consistently. Same as differential or difference threshold.

kinesthetic receptors. Receptors located in the muscles, tendons, and joints by means of which we perceive the movements and position of parts of the body; can also include receptors of the nonauditory labyrinth. *See* proprioceptors.

Ladd-Franklin theory. An evolutionary theory of color vision which postulates that substances photosensitive to yellow and to blue evolved from a more primitive, black-white substance, and that later substances photosensitive to red and green evolved from the yellow substance.

language. A set of conventionalized symbols and signs having consistent and meaningful relations to one another used in communication.

latency. The period of time between the presentation of a stimulus and the occurrence of a response. Also called response latency.

latency stage. In psychoanalytic theory, a period of development in later childhood during which time the impulses and feelings of the earlier stages are repressed and inactive.

latent content. A psychoanalytic term denoting the unconscious meaning underlying a dream.

lateral dominance. The use of one side or one part of one side of the body more than the other; e.g., handedness or eyedness.

law of effect. Reactions followed by rewards will be learned, and reactions followed by nonrewards will not be learned.

learning. The relatively permanent change in behavior which occurs with practice or response to some specific situation.

learning curve. A graph describing how performance changes with practice.

level of aspiration. The level of performance which a person believes himself capable of attaining.

leveling. The simplification and loss of detail in remembered material.

lie detector. An apparatus for recording emotional responses during interrogation.

life-study method. The systematic study of an individual's life history and present behavior.

light adaptation. Progressively decreased sensitivity of the visual receptors in the presence of light stimulation.

linear perspective. The apparent convergence of parallel lines and decreased size of objects with increasing distance; a factor in depth perception.

linguistics. The study of the structures of language systems.

loudness. A psychological characteristic of a sound, judged as the magnitude or degree of sound intensity.

LSD-25. A lysergic acid derivative which produces temporary conditions resembling some schizophrenic symptoms.

manic-depressive psychosis. An effective disorder in which there are drastic mood changes—from hyperactivity, elation, and destructive mania to deep depression and severe apathy. The pattern of change may be regular or irregular.

manifest content. According to psychoanalytic theory, the conscious content of a dream. The events of the dream as described by the dreamer.

massed practice. Nonspaced successive trials within one learning period; e.g., cramming for an examination. *Cf.* distributed practice.

maturation. Differentiation of function that occurs independently of response to specific environmental situations; differentiation of function that is not learned.

mean (arithmetic). A measure of central tendency. That value which is the arithmetic average of all values in a distribution; the sum of all scores divided by the number of scores.

median. A measure of central tendency. That value in a distribution above which 50 percent of the cases fall and below which 50 percent of the cases fall.

medulla. That part of the brain stem just above the spinal cord, the principal function of which is the regulation of vital activities, such as breathing.

memory. An aspect of learning; the retention of learned change in behavior.

memory drum. A device for presenting material, such as nonsense syllables, in sequence and for controlled intervals of time.

memory forms. The perceptual organization of remembered material or events.
memory savings. The amount of retention measured in terms of the time or effort saved in relearning as against original learning.
memory span. The quantity of material (e.g., a series of numbers) that can be reproduced without error immediately after one presentation.
mental age (M.A.). A relative measure of intelligence or mental growth. An individual's mental age is determined by his performance on standard test items in relation to the performance of the average person of his age group. *See* intelligence quotient.
mesomorphy. A component or dimension of body build or somatotype, characterized chiefly by the predominance of muscular tissue. (Sheldon.)
method of average error. A psychophysical method in which the subject adjusts a variable stimulus until it matches some standard.
method of constant stimuli. A psychophysical method in which a standard stimulus is compared to a number of discrete variable stimuli a large number of times.
method of paired comparisons. A psychophysical method and a psychological scaling procedure in which stimulus samples or objects are systematically compared one against the other, taking all possible pairs one at a time.
midbrain. The middle region of the three major subdivisions of the brain, important in the regulation of general activity and posture.
millimicron ($m\mu$). One millionth of a millimeter.
Minnesota Multiphasic Personality Inventory (MMPI). A personality inventory based on clinical categories which is used in two forms: as an individual card-sorting inventory and as a booklet for group testing.
mode. A measure of central tendency. That point or score in a distribution which occurs most frequently.
Moro reflex. A response given by infants to jarring, loud sounds, or other sudden unexpected stimuli. Primarily an extensor reflex, in which the arms and head are extended, the back arched.
moron. A person with an I. Q. ranging from 51 to 70.
motion analysis. Any one of several techniques for analyzing in detail the form, speed, accuracy, force, and integration of human movements. Motion study.
motivation. The events related to motivated activity; i.e., the conditions, internal and external, involved in persistent goal-directed activity.
motivational theory. A theory of personality emphasizing factors of motivation, as contrasted with traits or perceptual factors.
motive. A particular drive condition or need which directs behavior toward a goal or incentive.
motor neuron. A neuron which transmits impulses from the central nervous system to an effector, i.e., a muscle or gland. An efferent neuron.
motor skill. The ability of an individual to control the force, accuracy, timing, and magnitude of movements so as to produce patterns which are coordinated in space, time, and in relation to physical objects.
multiple causation. The principle that the occurrence of a particular response or form of behavior is determined by more than one factor.
mutation. A change in the chemical structure of the genes which can be transmitted to the next generation.

negative reinforcement. The use of a negative reinforcer (noxious stimuli) or withdrawal of a positive reinforcer (reward) in controlling learning.
neonatal period. The first month of life following a full-term birth.
nerve. A bundle of nerve fibers.
nerve fiber. The threadlike filament extending from the cell body of the neuron which conducts the nerve impulse to or from the synapse.
nerve impulse. The electrochemical change that is propagated along a single neuron.
nervous system. An inclusive term for the complex network of neurons in the body; divided into central nervous system and peripheral nervous system.
neural facilitation. Increase in amount of activity in one fiber or nerve by the on-going activity of another fiber or nerve.
neural inhibition. The reduction or blocking of activity in one fiber or nerve by the on-going activity in another fiber or nerve.
neurohumoral regulation. Regulation of activity through the integrated action of the nervous and endocrine systems.
neuron. A single nerve cell; the anatomical unit of the nervous system.
neurosis. A functional disorder, less severe than a psychosis, characterized chiefly by sustained anxiety.
nonauditory labyrinth. The semicircular canals and vestibule of the inner ear, in which are located receptors concerned with the perception of body position and movement.
nondirective interview. A form of interview in which the interviewer reflects the feelings of the interviewee so that he is encouraged to talk freely about his problems, plans, and accomplishments. Permissive interviewing.
nondirective therapy. Permissive counseling therapy utilizing nondirective interviewing methods.
nonsense syllables. Combinations of letters, usually a vowel between two consonants, used as material for learning experiments as units of equal difficulty which avoid familiarity in meaning.
nor-adrenalin. A hormone secreted by the adrenal medulla related to emotional reactions of rage.
norm. A standard which describes the performance or characteristics of a large group of people against which other individuals can be compared; e.g., norms for intelligence or infant motor development. In social

behavior, a standard of behavior as defined by a group, society, or culture.

normal distribution curve. A theoretical frequency distribution curve the properties of which can be described in exact mathematical terms according to the laws of chance. It serves as a standard against which actual distributions are compared and evaluated.

nystagmus. An eye-movement pattern composed of alternate pursuit movements and fast saccadic jerks.

obsession. A compulsive idea or pattern of behavior.

occipital lobe. The posterior part of the cerebral cortex which receives afferent nerve impulses from the retinas. The primary sensory projection center for vision.

oedipal stage. In psychoanalytic theory, a stage of psychosexual development in which the child develops an erotic attachment to the parent of the opposite sex and hostile feelings toward the parent of the same sex.

Oedipus complex. Attachment to parent of opposite sex. *See* oedipal stage.

olfaction. Smell perception.

olfactorium. An odor-free room used in experiments on smell.

operant learning. Learning in which reward or reinforcement is dependent on what the learner does. Contrasted to "passive" learning in classical conditioning.

oral stage. In psychoanalytic theory, the first stage of psychosexual development, in which all gratification and pleasure are concerned with the mouth and taking nourishment.

ordinate. The vertical axis of a graph.

organ of Corti. The supporting structure for the receptors of hearing, the hair cells. Located on the basilar membrane.

organic disorder. A behavior disorder which can be traced to a specific organic condition; e.g., general paresis.

organic receptors. Receptors, mostly undifferentiated nerve endings, located in and around the major organs and blood vessels of the body. Important in hunger perception, nausea, internal pain, etc.

oval window. A part of the inner ear to which is attached the third of the middle ear bones, the stirrup. The oval window "opens" into the cochlear canals.

ovaries. The female sex glands.

overlearning. Usually, learning that occurs after one errorless performance has been achieved.

paranoia. A psychosis in which a person shows a logical and systematized organization of delusions. Not to be confused with paranoid schizophrenia.

parapsychology. The study of psychological events which are alleged to have a nonphysical, or at least an unknown basis. *See* extrasensory perception.

parasympathetic nervous system. The cranial-sacral division of the autonomic nervous system, dominant in relaxed, pleasant states.

parathyroid glands. Two pairs of ductless glands embedded in the thyroid gland, the hormonal output of which regulates the calcium and phosphorous level in the body.

paresis. A disease of the central nervous system caused by syphilis, leading to marked disturbances in memory, speech, and motor skill.

partial hunger. Hunger for specific food substances or elements, such as a particular mineral. Contrasted to the general need for food, or bulk-food hunger.

partial reinforcement. Reinforcement of a particular response only part of the time.

patterned interview. An interview which follows a standardized list of questions. The interviewee is allowed considerable freedom of discussion.

percentile score. A score represented by a point or value in a distribution below which a specified percentage of a distribution falls. A percentile score of 90 means that 90 percent of the distribution of scores falls below the raw score in question. Centile score.

perception. The process of responding differentially to specific stimuli.

perceptual constancy. The tendency for perceived objects to remain constant in size, brightness, color, etc., despite changes in the stimulating conditions.

perceptual equivalence. The psychological or behavioral similarity of two perceived objects which differ in some physical aspect; e.g., the similarity of triangularity seen in two distinct types of triangles.

perceptual motivation. The patterning of behavior according to the motivating value of environmental stimuli and conditions.

perceptual organization. The arrangement and patterning of perceived stimuli in time and space.

performance test. A psychological test relatively independent of verbal behavior. A nonverbal test.

peripheral nervous system. The nerves and ganglia lying outside the brain and spinal cord.

peripheral theory of thought. The sensory feedback theory that thinking consists of sequences of responses continuously dependent on receptor stimulation and control. Contrasted with central theory of thought.

personality. The overall expression of an individual's adjustive response patterns in all the different situations that structure his life.

personology. Restricted systems of reading personality by short-cut methods, usually of dubious or no scientific value. Has also been used in a more general sense to refer to the psychology of personality.

phallic stage. In psychoanalytic theory, a stage of psychosexual development in which pleasure is centered around the sexual organs and autoerotic expressions.

phi phenomenon. A form of apparent movement induced by the alternate presentation of two discrete stimuli or stimulus objects.

phobia. An intense, unreasonable fear of some object or situation.

phonemes. The so-called sound units of speech, as classified in linguistic study.

phrenology. An outmoded and unscientific system of character reading and personality study based upon the analysis of the size and location of "bumps" on the head.

physiological need. Any physiological demand which the body requires for normal function or survival; e.g., oxygen, food.

physiological psychology. The study of behavior in relation to different aspects of physiological interaction or function.

Picture Arrangement Test (PAT). A projective test in which an individual puts a series of pictures into a sequence so as to make a meaningful story.

pitch. The psychological attribute or quality of a sound related most directly to the frequency of the sound stimulus; e.g., high and low notes.

pituitary gland. The "master gland" of the endocrine system located just below the brain. It secretes various hormones most of which facilitate or inhibit the action of other endocrine glands.

place theory. A theory of pitch discrimination which holds that perceived pitch is dependent upon the place on the basilar membrane maximally stimulated.

plantar reflex. Flexion of the toes elicited by stroking the sole of the foot. *See* Babinski reflex.

plateau. An interval of no improvement in learning followed by further learning as practice continues.

play therapy. Therapy in which the child is permitted unrestricted expression of his conflicts through play activities with dolls, toys, etc.

positive reinforcement. The use of a positive reinforcer (reward) or the withdrawal of a negative reinforcer (noxious stimuli) in controlling learning.

posthypnotic suggestion. A specific suggestion given to a person during hypnosis, which is to be carried out after the individual returns to the waking state.

postnatal motor sequence. The period between birth and the third year after birth in which the child develops all of the basic patterned motions.

prefrontal lobotomy. A surgical procedure in which the neural connections of the prefrontal part of the brain are severed from the rest of the brain. Occasionally used as therapy for extreme emotional depression and anxiety.

prejudice. Literally, a pre-judgment. An emotionally based attitude for or against an issue, individual, or group, which ignores relevant objective criteria of judgment.

preparatory set. The tendency or readiness to respond.

primary colors. Those hues which when mixed in the proper proportions will produce all other hues of the spectrum. In normal vision there are three primaries: a red, a green, and a blue.

primary mental abilities. Relatively independent abilities such as word fluency, number ability, perceptual ability, etc., isolated by factor analysis, and which taken together make up intelligent performance.

primary motives. Motives related to specific physiological needs; e.g., hunger and thirst.

primary motor areas. Those parts of the cerebral cortex lying directly in front of the central sulci which constitute the motor areas for fine skilled movements.

problem box. A device used in studying learning in which an animal must manipulate something (a latch, a string, etc.) in order to escape or to enter.

progesterone. A hormone secreted by the corpus luteum of the ovary which is important in maintaining pregnancy.

projection. Attributing one's own motives or characteristics to others.

projection area. An area of the cerebral cortex in which some specific sensory or motor system is represented; e.g., the visual cortex.

projective test. A personality test consisting of ambiguous perceptual material capable of many different interpretations. In responding to such material the individual "projects" his own desires, attitudes, fears, etc., into his description.

prolactin. A pituitary hormone which stimulates milk production.

proprioceptors. Receptors in muscles, tendons, and joints and in the nonauditory labyrinth which give information concerning bodily position and movement. Also called kinesthetic receptors.

protanopia. A form of red-green blindness in which the visible spectrum is shortened at the red end.

psychiatrist. A doctor of medicine who specializes in the treatment of behavior disorders.

psychoanalysis. A theory of behavior and a technique of psychotherapy originated by Sigmund Freud.

psychoanalytic interview. The form of interview used in psychoanalytic therapy, emphasizing "free association," the description of every thought which occurs to the patient, and detailed accounts of dreams and fantasies.

psychoanalytic theory. A theory of personality and behavior stressing unconscious motivation, psychosexual development, and early experience.

psychodrama. Group psychotherapy involving therapeutic role playing.

psychographic profile. A bar or line graph describing the pattern of several measures of response or of personality for an individual or a group.

psycholinguistics. The study of the relationship between the structure of language and verbal behavior. The science of verbal communication.

psychological scales. Scales based on psychological reference standards; e.g., an attitude scale or a scale of loudness.

psychology. The science of behavior.

psychomotor test. A psychological test which measures perceptual-motor ability.

psychoneurosis. Neurosis (*q.v.*).

psychopathic deviation. Behavior of an antisocial nature. A person whose behavior is so described is called a psychopathic deviate or psychopathic personality.

psychopharmacology. The study of behavior in relation to pharmacological or chemical factors.

psychophysical methods. Methods used in studying numerous aspects of perception and judgment.

psychophysics. The quantitative study of the relationships between psychological dimensions of perception and physical properties of stimuli.

psychosis. Severe behavior disorder, either organic or functional, which usually requires hospitalization.

psychosomatic disorder. An organic disorder, such as high blood pressure or ulcers, induced by emotional disturbance.

psychotherapy. Treatment by psychological means.

punctiform sensitivity. Localized or "spot" sensitivity of the skin to warmth, cold, touch, and pain stimuli.

punishment. The occurrence of a negative reinforcer (noxious stimulus) or withdrawal of a positive one (reward).

pupil. The variable opening in the iris which admits light to the eye.

pupillary reflex. The contraction or dilation of the pupil of the eye to an increase or decrease in light intensity.

Purkinje shift. The shift in the relative brightness of different wavelengths in changing from high to low levels of illumination. The point of maximum brightness shifts from greenish-yellow to green.

pursuit movement. The relatively slow, controlled movement of the eyes in following a moving object.

pyknic type. One of Kretschmer's body types—short, fat. Allegedly associated with manic-depressive psychosis.

range. A measure of variability defined as the difference between the highest and lowest score in a distribution.

rating scale. A quantitative scale for making judgments of the variation in a series of psychological factors; e.g., a scale for rating people in regard to personality characteristics.

rationalization. The giving of socially acceptable reasons for one's actions and motives.

reaction formation. Denial of unacceptable motives and traits by developing their opposites in extreme forms.

reaction time. The time intervening between a stimulus and a response to it.

recall. Reproduction of remembered material based on minimal cues from the material itself, as in an essay-type examination.

receptor. A specialized cell or end organ which responds selectively to some form of energy or energy change; e.g., a rod or cone of the eye.

reciprocal innervation. Reflex integration in neural centers by means of which one of a pair of antagonistic muscles is made to contract while the other relaxes.

recognition. Aided recall of remembered material, as in multiple-choice examination questions.

reconstruction. A form of memory in which learned material must be reproduced in terms of content and order; e.g., memory of a poem. Also called serial reconstruction.

reflex. A restricted, unlearned form of movement or glandular response, consistently related to specific forms of stimuli.

regression. Adoption of an earlier or more childlike form of response as a frustration reaction.

reinforcement. The effects of reward and punishment on learning.

reinforcement theory. A learning theory based on the principle that behavior patterns are learned insofar as they reduce a need or drive.

reliability. The consistency of a series of measurements, usually expressed in terms of a correlation coefficient between two sets of measurements. *See* reliability coefficient.

reliability coefficient. A correlation coefficient which expresses the reliability of a test or method of measurement. It can be obtained by giving the same test twice, by correlating the results of one half of the test with the other half, or by giving two different forms of the same test. *See* split-half reliability.

repression. A psychoanalytic concept describing the tendency to exclude from conscious experience various perceptions, motives, memories, etc., which would be unpleasant and anxiety provoking if consciously expressed.

reproductive interference. Interference in retention of a first response due to the interpolation of a second response between learning the first and its reproduction. Also called retroactive inhibition.

respondent. One who responds, as to test or interview questions.

response. Reaction to stimulation.

response generalization. The elicitation by a specific stimulus or situation of a type of response different from but equivalent in effect to that learned originally in the situation.

response mechanism. The bodily systems which define behavior.

retention curve. A graph representing the retention of learned material; ordinarily the converse of the curve of forgetting.

retina. The posterior interior surface of the eye, containing visual receptors.

reward. The occurrence of a positive reinforcer or withdrawal of a negative one (noxious stimulus).

rod. One of the two types of visual receptors, so named because of its rodlike structure. Rods subserve achromatic vision, and, since they have a lower absolute

threshold than cones, function at lower levels of illumination.

role playing. A procedure of training or group psychotherapy in which social roles are acted out.

root theory. The theory that language develops by the progressive integration of isolated and single sound units into larger and more complex vocal responses.

Rorschach test. A projective test consisting of a number of inkblots which the subject describes in terms of objects represented, movement, form, etc.

saccadic movement. The quick jump or travel movement of the eyes from one point of fixation to another.

saccule. One of the vestibular "sacs" located below the semicircular canals.

saturation. A psychological dimension of perceived chroma which is judged as the amount of hue or chroma in a sample.

savings. Memory savings (*q.v.*).

scapegoating. A form of displaced aggression directed toward an innocent individual or group, typically a minority. *See* prejudice.

scattergram. A graphic representation of the degree of correlation between two sets of measures.

schemata. Organizations of memories in meaningful structures or patterns.

schizoid. A personality type described as shy, sensitive, aloof, and introverted. Resembles schizophrenia and is allegedly associated with the asthenic body type. (Kretschmer.)

schizophrenia. A major form of psychosis, noted for extreme withdrawal behavior, hallucinations, regression, and sometimes paranoid tendencies.

secondary goals. Goals which are developed through learning; contrasted to primary goals, which satisfy physiological needs.

secondary motives. Derived motives developed through learning; e.g., economic motives. Synonymous with learned motives.

secondary reinforcement. Reinforcement by a stimulus which has reinforcing value through association with a source of primary reinforcement.

selective adaptation. Differential adaptation, as in the case of odors. Some components of a complex odor are adapted to more quickly than others.

self. The perceived or judged organization of one's own make-up.

self-inventories. Personality questionnaires which an individual answers on the basis of likes, dislikes, preferences, opinions, etc.

semantic differential. A technique for studying the meaning of words by rating them on scales of adjective opposites.

semantic generalization. Generalization which occurs among words similar in meaning rather than in visual or auditory characteristics. *See* stimulus generalization.

semicircular canals. A set of three canals in the inner ear which contain receptors for perception of body position and movement.

senescence. The terminal period of life; the period of aging.

sensory neuron. A neuron which transmits impulses from a receptor to the central nervous system. An afferent neuron.

sensory preconditioning. A procedure whereby two stimuli are presented together for a number of trials, after which one of them is used as the CS in a conditioning experiment. After conditioning the other stimulus now evokes the CR, although it was never used in training.

serial position effect. The relative rate at which sequential units are learned. When material arranged in a series is learned, the units at the ends are learned first, while more errors occur in the middle.

serotonin. A hormone found in the brain which inhibits synaptic communication. Chemically similar to adrenalin.

set. The readiness or tendency to respond in a particular way. Preparatory set.

sex-linked inheritance. Transmission of a trait other than sex by genes carried in the X chromosome. Sex-linked traits are recessive but appear in males because the recessive gene has no dominant mate in the Y chromosome.

shock therapy. Therapy involving physiological shock used to treat psychotic patients; e.g., insulin shock, electroshock.

sibling. A brother or sister.

simultaneous contrast. A visual induction phenomenon whereby the appearance of one part of the visual field is influenced by an adjacent part.

skewed distribution. An asymmetrical distribution.

smooth muscles. Muscles found in the walls of the viscera and blood vessels consisting of spindle-shaped, unstriped fibers.

social age. A relative measure of social competence analogous to mental age.

social aggregation. A collection of individuals who engage in common behavior, but do not interact in a systematic way.

social environment. The stimulating conditions of the external environment defined by the presence of other people.

social facilitation. Increased motivation in a particular task due to the presence of other individuals.

social generalization. Generalization of the social prestige of one person to members of his family or close associates.

social mobility. The degree to which individuals change status and class identification within a society.

social motives. Motives necessitating some form of social behavior for their satisfaction.

social norm. A group standard; a pattern of behavior enforced by social pressure.

social-perceptual theory. A theory that personality is organized primarily in terms of social motivation, social learning, or social perception.

social psychology. A field of psychology concerned with the behavior of individuals in groups.

social role. A pattern of social behavior defined by the structure of society, requiring particular traits and abilities.

social status. The position occupied by a person relative to the needs of society; or the prestige value of an individual's position.

somatotonic. A kind of personality or temperament characterized by vigor, adventurousness, and competitiveness. According to Sheldon, correlated with mesomorphy.

somatotype. The characterization of body build or type as developed by Sheldon and his associates; defined by the relative prominence of ectomorphic, endomorphic, and mesomorphic characteristics.

sound spectrograph. A device for transforming auditory signals into a visible record on a moving luminescent tape.

sound wave. Alternating changes in pressure propagated through a medium, such as air or water, to which the auditory receptors are sensitive.

specific nerve energies. Historically, the name given to the basic principle of perceptual organization, which states that a receptor system responds in terms of its own special properties irrespective of the physical properties of the stimuli affecting it.

split-half reliability. An expression of the internal consistency of a test derived from correlating its two halves.

spontaneous recovery. Reappearance at a later time of a learned response after it has been subjected to experimental extinction.

standard deviation. A measure of variability of a distribution, symbolized by the Greek letter, σ. It is the root mean square of the deviations of all scores from the mean.

standard score. A score based on standard deviations from a mean.

standardization. The establishment of norms for a test by giving it to a sample population representative of the individuals for whom the test is intended.

Stanford-Binet test. One of our most widely used individual intelligence tests; a mental age scale derived from Binet's original tests and standardized for American use by Terman and his associates.

startle pattern. An unlearned generalized response to a sudden intense stimulus. The body crouches slightly, the shoulders are lifted, and the arms are drawn forward.

statistical significance. A statement of the dependability of a measure in representing an event, in terms of how often it could occur by chance. When it might occur no oftener than once out of 20 times, a result is described as statistically significant.

stereoscope. A device for presenting two disparate views of an object or scene, one to each eye, thus producing stereoscopic vision.

stereoscopic vision. Three-dimensional vision which depends upon the integration of disparate retinal images.

stimulus. A form of energy which excites receptors and produces a response or change in behavior.

stimulus generalization. Transfer of a response from the stimulus or situation in relation to which it was originally learned to a different stimulus or situation.

stimulus inhibition. Temporary blocking or suppression of a conditioned response due to the occurrence of another stimulus just prior to the conditioned stimulus.

stimulus threshold. The least amount of energy which will excite a receptor or receptor system. In its usual sense, a threshold is a statistical concept, not a single absolute measure.

stress. Excessive deprivation, demands, or stimulation to which the individual cannot adjust readily.

stress interview. An interview utilizing some form of stress, such as vigorous, unsettling questions, to determine the interviewee's stability under pressure.

striped muscles. The kind of muscles usually attached to the bony skeleton which consist of long striated (striped) fibers.

sublimation. During frustration, the substitution of a more complex form of social behavior for the blocked pattern of activity.

subtractive mixture. The combination of materials, such as pigments, which absorb light, with the result that the mixture reflects or transmits less energy than any of the components. *Cf.* additive mixture.

successive contrast. Visual induction due to the persistence of effects of visual stimulation in time. A negative after-image.

suggestibility. The degree to which the course of behavior in an individual can be influenced by specific instructions or example.

superego. The Freudian term denoting the "critical self," represented by the internalization of rewards and punishments as their effects are learned in formative years. Commonly, one's conscience.

syllable. The fundamental unit of speech consisting of a discrete pulse of air forced upward through the vocal canal, which is characterized by vowel quality and sometimes consonant factors and tone.

symbolic behavior. A pattern or course of behavior defined by the use of symbols; e.g., thinking.

sympathetic nervous system. The thoraco-lumbar division of the autonomic nervous system, dominant in rage, fear, and other strong emotions.

synapse. The functional connection between two or more nerve fibers.

synaptic conduction. The transmission of neural activ-

ity across the gap between nerve fibers. The transmission is of an electrical or chemical nature, or both.
syndrome. The pattern of symptoms or behavior characteristics used to identify a particular disease or behavior disorder.

temporal maze. A maze which requires a certain temporal sequence of movements not differentiated spatially. *See* double alternation.
test battery. A group of subtests which samples different kinds of abilities or characteristics.
testes. The male sex glands.
testosterone. A hormone secreted by the testes which affects male sex behavior directly and also regulates the development of secondary male sex characteristics.
thalamus. That part of the forebrain which serves as the main way-station between the sensory systems of the body and the cerebral cortex. Its action is closely integrated with that of the hypothalamus.
Thematic Apperception Test (TAT). A projective test consisting of a series of pictures not highly structured in action content about which the subject must tell stories. His personality is interpreted in terms of the motives which he attributes to the main characters in his stories.
theory. A set of interrelated assumptions, facts, and principles which explains a phenomenon or group of phenomena and is used to suggest new hypotheses that can be tested by experiment.
therapy. Treatment of a disease or behavior disorder.
thinking. The use and manipulation of abstract symbols, and integration of past experiences without overt trial and error. Usually a form of rapid learning.
threshold. Stimulus threshold. *See* absolute threshold, difference threshold, stimulus threshold.
thyroid gland. A ductless gland located in the neck which helps regulate activity level and metabolic rate. Secretes thyroxin.
thyroxin. A hormone produced by the thyroid gland (*q.v.*).
tic. An uncontrollable, repetitive movement, relatively limited in extent.
timbre. The psychological attribute of sound commonly referred to as tone quality. It is related most directly to the pattern of frequencies making up a complex sound stimulus. Two different instruments playing the same note differ in timbre.
token-reward learning. Learning to use derived or secondary incentives such as tokens or money.
topological psychology. A conception of behavior in terms of an individual's "life space" or behavioral field. Behavior is explained by the nature of the attracting and repelling forces (valences) within this space or field.
trait. A relatively stable characteristic of behavior or habit pattern that differentiates among individuals.
trait theory. A theory which conceives personality as consisting of a number of specific traits or characteristics, such as intellectual traits, perceptual traits, etc.
tranquilizer. A therapeutic drug used to reduce emotional disturbance and anxiety; e.g., reserpine, chlorpromazine.
transfer of training. The carry-over of the effects of learning in one situation to another. If the second learning is facilitated, the effect is called positive transfer; if retarded, it is called negative transfer.
transference. A stage in psychotherapy, considered a necessary stage of psychoanalysis, in which the therapist becomes the object of emotional reactions of the patient.
trichromatism. Normal color vision, in which all colors can be matched by mixtures of three primary hues.
tritanopia. A rare form of color blindness in which the individual shows a weakness in the blue region of the spectrum. The perception of yellow also may be affected.
T-score. A form of standard score based upon a scale with a mean of 50 and a standard deviation of 10.
two-point threshold. A difference threshold defined by the smallest distance between two points of stimulation on the skin that can be discriminated reliably as two points. Also called the two-point limen.
tympanic membrane. The eardrum.

unconditioned stimulus. The stimulus in conditioning which evokes the unconditioned response; e.g., the puff of air on the eye which produces blinking.
unconditioned response. The original response given to the unconditioned stimulus; e.g., the blink given to a puff of air on the eye.
utricle. One of the vestibular "sacs" located below the semicircular canals.

validity. The degree to which a test or method measures what it is supposed to measure; usually expressed by a coefficient of correlation between a set of measures and an "outside" criterion.
validity coefficient. A correlation coefficient expressing the validity of a test or method of measurement.
variability. The degree to which the different measures in a distribution deviate from the mean. The standard deviation is the most commonly used measure of variability.
variables. The factors in an experiment which vary and are measured or controlled.
viscerotonic. A kind of personality or temperament characterized by love of comfort, eating, etc. According to Sheldon, correlated with endomorphy.
visible spectrum. That part of the electromagnetic spectrum between approximately 400 and 750 millimicrons which the normal observer perceives as light.
visual acuity. The resolving power of the visual system measured as the ability to discriminate fine detail.
visual perimeter. A device used for mapping the visual field (e.g., retinal color fields) of each eye.

volley principle. The principle that sounds of frequencies higher than the maximal rate of responding of a single nerve fiber can be represented in the auditory nerve by composite volleys of impulses in groups of fibers.

Weber ratio. A ratio of the size of the difference threshold and the magnitude of the stimulus at which the threshold was obtained. For most perceptual dimensions this ratio is fairly constant in the middle range of stimulus values and also smallest in this range. Also called Weber fraction.

Weber's law. The statement that the size of a just noticeable difference between stimuli is a relatively constant fraction of the standard stimulus value. *See* Weber ratio.

Wechsler Adult Intelligence Scale. An individual intelligence test designed for adults, with both verbal and performance items.

Young-Helmholtz theory. A theory of color vision postulating the existence of three types of receptors for hue, one maximally sensitive to the red region of the spectrum, one to the green, and one to the blue.

z-score. A standard score obtained by dividing the difference between a raw score and the mean of the distribution by the standard deviation of the distribution.

References

Many original sources are listed in captions throughout the book. The following references are those referred to by superscript numbers in the text. They are grouped according to chapters, and the page number in parentheses follows the footnote number.

CHAPTER 1. THE SCIENCE OF PSYCHOLOGY

1.(*14*) Kohler, I. Warum sehen wir aufrecht? *Die Pyramide*, 1951, **2**, 30-33; Kohler, I. *Die Method des Brillenversuchs in der Wahrnehmungspsychologie mit Bemerkungen zur Lehre von der Adaptation.* Mimeograph. Innsbruck, Austria: Institut für Experimentelle Psychologie, 1955.

2.(*22*) Boring, E. G. *A history of experimental psychology.* (2nd Ed.) New York: Appleton-Century-Crofts, 1950.

3.(*24*) Freud, S. *The basic writings of Sigmund Freud.* (Ed. and trans. by A. A. Brill.) New York: Modern Library, 1938.

4.(*25*) Köhler, W. *Gestalt psychology.* New York: Liveright, 1929.

5.(*25*) Pavlov, I. P. *Conditioned reflexes.* (Trans. by G. V. Anrep.) London: Oxford Univ. Press, 1927.

6.(*25*) Watson, J. B. *Behaviorism.* New York: Norton, 1924.

CHAPTER 2. ADJUSTIVE BEHAVIOR

1.(*33*) Terman, L. M., et al. *Genetic studies of genius.* Vol. 1. *Mental and physical traits of a thousand gifted children.* Stanford, Calif.: Stanford Univ. Press, 1925; Terman, L. M., and Oden, M. H. *Genetic studies of genius.* Vol. 4. *The gifted child grows up.* Stanford, Calif.: Stanford Univ. Press, 1947.

CHAPTER 3. THE ORGANIZATION OF BEHAVIOR

1.(*63*) Freud, S. *The basic writings of Sigmund Freud.* (Ed. and trans. by A. A. Brill.) New York: Modern Library, 1938.

2.(*73*) Hunt, J. McV. The effects of infant feeding frustration upon adult hoarding in the albino rat. *J. abnorm. soc. Psychol.*, 1941, **36**, 338-360; Hunt, J. McV., Schlosberg, H., Solomon, R. L., and Stellar, E. Studies of the effects of infantile experience on adult behavior in rats: I. Effects of infantile feeding frustration on adult hoarding. *J. comp. physiol. Psychol.*, 1947, **40**, 291-304.

3.(*75*) Miller, D. R., and Swanson, G. E. The study of conflict. In Jones, M. R. (Ed.) *Nebraska symposium on motivation.* Lincoln: Univ. Nebraska Press, 1956. Pp. 137-174.

4.(*76*) Dollard, J., et al. *Frustration and aggression.* New Haven: Yale Univ. Press, 1939.

5.(*76*) Miller, N. E., and Bugelski, R. Minor studies of aggression: II. The influence of frustrations imposed by the in-group on attitudes expressed toward out-groups. *J. Psychol.*, 1948, **25**, 437-442.

6.(*76*) Hovland, C. I., and Sears, R. R. Minor studies of aggression: VI. Correlation of lynchings with economic indices. *J. Psychol.*, 1940, **9**, 301-310.

7.(*78*) James W. *The principles of psychology.* Vol. 1. New York: Holt, 1890.

8.(*81*) Anderson, R. G. Reported and demonstrated values of vocational counseling. *J. appl. Psychol.*, 1949, **33**, 460-473.

9.(*82*) Axline, V. M. *Play therapy.* Boston: Houghton Mifflin, 1947.

10.(*82*) Lewin, K., Lippitt, R., and White, R. K. Patterns of aggressive behavior in experimentally created "social climates." *J. soc. Psychol.*, 1939, **10**, 271-299; Moreno, J. L. *Psychodrama.* New York: Beacon House, 1946.

11.(*82*) Maier, N. R. F. *Principles of human relations: applications to management.* New York: Wiley, 1952.

12.(*83*) Maier, N. R. F. *Psychology in industry.* (2nd Ed.) Boston: Houghton Mifflin, 1955.

CHAPTER 4. MAN AS A BEHAVING ORGANISM

1.(*87*) Daniel, R. S., and Smith, K. U. The sea-approach behavior of the neonate loggerhead turtle, *caretta caretta. J. comp. physiol. Psychol.*, 1947, **40**, 413-420.

2.(*89*) Fisher, A. E. Maternal and sexual behavior induced by intracranial chemical stimulation. *Science*, 1956, **124**, 228-229.

3.(*91*) Dempsey, E. W. Homeostasis. In Stevens, S. S. (Ed.) *Handbook of experimental psychology.* New York: Wiley, 1951. Pp. 209-235.

4.(*92*) Ingram, W. R. The hypothalamus. *Ciba clinical Symposia*, 1956, **8**, 117-156.

5.(*112*) Marrazzi, A. S. Messengers of the nervous system. *Sci. Amer.*, 1957, **196** (2), 86-94.

CHAPTER 5. THE DEVELOPMENT OF BEHAVIOR

1.(*122*) Dice, L. R. Heredity and population betterment. *Sci. Monthly*, 1952, **75**, 273-279.

2.(*127*) Newman, H. H., Freeman, F. N., and Holzinger, K. J. *Twins: a study of heredity and environment.* Chicago: Univ. Chicago Press, 1937.

3.(*128*) Carmichael, L. A further study of the development of behavior in vertebrates experimentally re-

moved from the influence of external stimulation. *Psychol. Rev.*, 1927, **34**, 34-47.

4.(*128*) Dennis, W. Spalding's experiment on the flight of birds repeated with another species. *J. comp. Psychol.*, 1941, **31**, 337-348.

5.(*128*) Dennis, W. The effect of cradling practices upon the onset of walking in Hopi children. *J. genet. Psychol.*, 1940, **56**, 77-86.

6.(*129*) Hebb, D. O. *The organization of behavior.* New York: Wiley, 1949.

7.(*130*) Davis, K. Extreme social isolation of a child. *Amer. J. Soc.*, 1940, **45**, 554-565.

8.(*130*) Mason, M. K. Learning to speak after six and one-half years of silence. *J. Speech Disorders*, 1942, **7**, 295-304.

9.(*131*) Gesell, A., and Thompson, H. Twins T and C from infancy to adolescence: a biogenetic study of individual differences by the method of co-twin control. *Genet. Psychol. Monogr.*, 1941, **24**, 3-121; Hilgard, J. R. The effect of early and delayed practice on memory and motor performances studied by the method of co-twin control. *Genet. Psychol. Monogr.*, 1933, **14**, 493-567.

10.(*131*) Kellogg, W. N., and Kellogg, L. A. *The ape and the child.* New York: McGraw-Hill, 1933.

11.(*131*) Hayes, K. J., and Hayes, C. The intellectual development of a home-raised chimpanzee. *Proc. Amer. phil. Soc.*, 1951, **95**, 105-109.

12.(*131*) Hess, E. H. Space perception in the chick. *Sci. Amer.*, 1956, **195** (1), 71-80.

13.(*133*) Hess, E. H. Effects of meprobamate on imprinting in waterfowl. *Annals N. Y. Acad. Sci.*, 1957, **67**, 724-733.

14.(*133*) Hooker, D. *The origin of overt behavior.* Ann Arbor: Univ. Mich. Press, 1944.

15.(*136*) Pratt, K. The neonate. In Carmichael, L. (Ed.) *Manual of child psychology.* (2nd Ed.) New York: Wiley, 1954. Pp. 215-291.

16.(*137*) Wenger, M. A. An investigation of conditioned responses in human infants. *Univ. Iowa Stud. Child Welf.*, 1936, **12**, No. 1.

17.(*137*) Wickens, D. D., and Wickens, C. A study of conditioning in the neonate. *J. exp. Psychol.*, 1940, **26**, 94-102.

18.(*142*) Stetson, R. H. *Motor phonetics.* Amsterdam: North-Holland Publ. Co., 1951.

19.(*142*) Smith, M. E. An investigation of the development of the sentence and the extent of vocabulary in young children. *Univ. Iowa Stud. Child Welf.*, 1926, **3**, No. 5.

20.(*142*) Hunter, W. S. The delayed reaction in animals and children. *Behav. Monogr.*, 1913, **2**, No. 6.

21.(*143*) Hunter, W. S., and Bartlett, S. C. Double alternation behavior in young children. *J. exp. Psychol.*, 1948, **38**, 558-567.

Chapter 6. Human Motivation

1.(*146*) Cannon, W. B. *The wisdom of the body.* New York: Norton, 1932.

2.(*148*) Tsang, Y. C. Hunger motivation in gastrectomized rats. *J. comp. Psychol.*, 1938, **26**, 1-17.

3.(*148*) Morgan, C. T., and Morgan, J. D. Studies in hunger: II. The relation of gastric denervation and dietary sugar to the effect of insulin upon food intake in the rat. *J. genet. Psychol.*, 1940, **57**, 153-163.

4.(*148*) Mayer, J. Appetite and obesity. *Sci. Amer.*, 1956, **195** (5), 108-116.

5.(*149*) Richter, C. P. Total self-regulatory functions in animals and human beings. *Harvey Lect.*, 1942-1943, **38**, 63-103.

6.(*149*) Davis, C. M. Self-selection of diet by newly weaned infants. *Amer. J. Dis. Child.*, 1928, **36**, 651-679.

7.(*151*) Wolf, A. V. Thirst. *Sci. Amer.*, 1956, **194** (1), 70-76.

8.(*151*) Monagle, J. E., Grande, F., Buskirk, E., Brozek, J., Taylor, H. L., and Keys, A. Body temperature during work in man on a restricted water intake and low caloric carbohydrate diet. *Federation Proc.*, 1956, **15**, No. 132.

9.(*152*) Cannon, W. B. Hunger and thirst. In Murchison, C. (Ed.) *A handbook of general experimental psychology.* Worcester, Mass.: Clark Univ. Press, 1934. Pp. 247-263.

10.(*155*) McCleary, R. A. and Morgan, C. T. Food-hoarding in rats as a function of environmental temperature. *J. comp. Psychol.*, 1946, **39**, 371-378.

11.(*156*) Kinsey, A. C., Pomeroy, W. B., and Martin, C. E. *Sexual behavior in the human male.* Philadelphia: Saunders, 1948; Kinsey, A. C., Pomeroy, W. B., Martin, C. E., and Gebhard, P. H. *Sexual behavior in the human female.* Philadelphia: Saunders, 1953.

12.(*157*) Altmann, M., Knowles, E., and Bull, H. D. A psychosomatic study of the sex cycle in women. *Psychosomatic Med.*, 1941, **3**, 199-225.

13.(*160*) Riddle, O., Bates, R. W., and Lahr, E. L. Maternal behavior in rats induced by prolactin. *Proc. Soc. exp. Biol., N. Y.*, 1935, **32**, 730-734.

14.(*160*) Kleitman, N. *Sleep and wakefulness.* Chicago: Univ. of Chicago Press, 1939.

15.(*161*) Edward, A. S. Effects of the loss of one hundred hours sleep. *Amer. J. Psychol.*, 1941, **54**, 80-91.

16.(*161*) Harris, S. *The effects of sleep loss on component movements in human motion.* Unpublished doctoral dissertation, Univ. of Wis., 1955.

17.(*161*) Johnson, H. M. Sleep. In Valentine, W. L. (Ed.) *Readings in experimental psychology.* New York: Harper, 1931. Pp. 241-291; Renshaw, S., Miller, V. L., and Marquis, D. *Children's sleep.* New York: Macmillan, 1933.

18.(*163*) Preparation for brainwashing. *Time*, Apr. 30, 1956, **67**, p. 48.
19.(*168*) Saltzman, I. J. Maze learning in the absence of primary reinforcement: a study of secondary reinforcement. *J. comp. physiol. Psychol.*, 1949, **42**, 161-173.
20.(*168*) Miller, N. E. Studies of fear as an acquirable drive: I. Fear as motivation and fear-reduction as reinforcement in the learning of new responses. *J. exp. Psychol.*, 1948, **38**, 89-101.
21.(*169*) Allport, G. W. *Personality: a psychological interpretation.* New York: Holt, 1937.

CHAPTER 7. EMOTION
1.(*177, 188*) Watson, J. B. *Psychology from the standpoint of a behaviorist.* (2nd Ed.) Philadelphia: Lippincott, 1924.
2.(*179*) Ellson, D. G. *A report of research on detection of deception.* Indiana Univ.: Off. Naval Res. Contract No. N6onr-18011, 1952.
3.(*179*) Berger, H. Über das Elektrenkephalogramm des Menschen. *Arch. Psychiat. Nervenkr.*, 1929, **87**, 527-570.
4.(*180*) Jones, F. P., and Kennedy, J. L. An electromyographic technique for recording the startle pattern. *J. Psychol.*, 1951, **32**, 63-68.
5.(*180, 193*) Cannon, W. B. *Bodily changes in pain, hunger, fear, and rage.* (2nd Ed.) New York: Appleton-Century-Crofts, 1929.
6.(*182*) Wallace, A. F. C. *Tornado in Worcester.* Washington, D. C.: Nat. Acad. Sci.—Nat. Res. Council, Publ. 392, 1956.
7.(*193*) Funkenstein, D. H. The physiology of fear and anger. *Sci. Amer.*, 1955, **192** (5), 74-80.
8.(*194*) Bard, P. A diencephalic mechanism for the expression of rage with special reference to the sympathetic nervous system. *Amer. J. Physiol.*, 1928, **84**, 490-515; Cannon, W. B. The James-Lange theory of emotions: a critical examination and an alternative theory. *Amer. J. Psychol.*, 1927, **39**, 106-124.
9.(*194*) Jameson, H. D., Settlage, P. H., and Bogumill, G. P. The effect of lesions in the amygdaloid area in monkeys. *J. gen. Psychol.*, 1957, **57**, 91-102.

CHAPTER 8. PERCEPTION: ITS GENERAL NATURE
1.(*210*) Stevens, S. S., and Davis, H. *Hearing, its psychology and physiology.* New York: Wiley, 1938.
2.(*210*) Wever, E. G., and Bray, C. W. Action currents in the auditory nerve in response to acoustical stimulation. *Proc. Nat. Acad. Sci.*, 1930, **16**, 344-350.
3.(*224*) Gilchrist, J. C., and Nesberg, L. S. Need and perceptual change in need-related objects. *J. exp. Psychol.*, 1952, **44**, 369-376.
4.(*226*) Senden, M. v. *Raum- und Gestaltauffassung bei operierten Blindgeborenen vor und nach der Operation.* Leipzig: Barth, 1932.
5.(*227*) Stratton, G. M. Vision without inversion of the retinal image. *Psychol. Rev.*, 1897, **4**, 341-360.
6.(*227*) Kohler, I. Warum sehen wir aufrecht? *Die Pyramide*, 1951, **2**, 30-33; Kohler, I. *Die method des Brillenversuchs in der Wahrnehmungspsychologie mit Bemerkungen zur Lehre von der Adaptation.* Mimeograph. Innsbruck, Austria: Institute für Experimentelle Psychologie, 1955.
7. (*227*) Foley, J. P., Jr. An experimental investigation of the effect of prolonged inversion of the visual field in the rhesus monkey. *J. genet. Psychol.*, 1940, **56**, 21-51.
8.(*228*) Smith, W. M., Smith, K. U., Stanley, R., and Harley, W. Analysis of performance in televised visual fields: preliminary report. *Percept. mot. Skills*, 1956, **6**, 195-198.

CHAPTER 9. PERCEPTION: OBSERVING THE WORLD
1.(*235*) Gibbs, C. B. *Car turning signals and delays in responding to visual information.* Medical Research Council Report; Applied Psychology Unit 176. London, England: Med. Res. Council, 1952.
2.(*236*) Data from G. Gallup as quoted in Hotchkiss, G. B. *An outline of advertising.* (3rd Ed.) New York: Macmillan, 1950.
3.(*237*) Baker, K. H. Pre-experimental set in distraction experiments. *J. gen. Psychol.*, 1937, **16**, 471-488.
4.(*246*) Supa, M., Cotzin, M., and Dallenbach, K. M. "Facial vision": the perception of obstacles by the blind. *Amer. J. Psychol.*, 1944, **57**, 133-183; Ammons, C. H., Worchel, P., and Dallenbach, K. M. "Facial vision": the perception of obstacles out of doors by blindfolded and blindfolded-deafened subjects. *Amer. J. Psychol.*, 1953, **66**, 519-553.
5.(*254*) Hartridge, H. Recent advances in color vision. *Science*, 1948, **108**, 395-404.
6.(*259*) Troland, L. T. *The principles of psychophysiology.* Vol. 1. *Problems of psychology and perception.* New York: Van Nostrand, 1929; Katz, D. *The world of colour.* London: Kegan Paul, 1935.

CHAPTER 10. LEARNING: ITS GENERAL NATURE
1.(*266*) James, W. *The principles of psychology.* (Vol. 1.) New York: Holt, 1890.
2.(*266*) Ebbinghaus, H. *Memory: a contribution to experimental psychology.* (Trans. by Ruger, H. A., and Bussenius, C. E.) New York: Teachers College, Columbia Univ., 1913.
3.(*266*) Thorndike, E. L. Animal intelligence: an experimental study of the associative processes in animals. *Psychol. Monogr.*, 1898, **2**, No. 8.
4.(*267*) Pavlov, I. P. *Conditioned reflexes.* (Trans. by G. V. Anrep.) London: Oxford Univ. Press, 1927.
5.(*268*) Köhler, W. *The mentality of apes.* New York: Harcourt, Brace, 1925.
6.(*268, 285, 290*) Skinner, B. F. *The behavior of organ-*

isms: an experimental analysis. New York: Appleton-Century-Crofts, 1938.

7.(*272*) Thorndike, E. L., Bregman, E. O., Tilton, J. W., and Woodyard, E. *Adult learning.* New York: Macmillan, 1928.

8.(*272*) Welford, A. T. *Skill and age.* London: Oxford Univ. Press, 1951.

9.(*272*) Woodrow, H. Interrelations of measures of learning. *J. Psychol.*, 1940, **10**, 49-73.

10.(*272*) Sarason, I. Effect of anxiety, motivational instructions, and failure on serial learning. *J. exp. Psychol.*, 1956, **51**, 253-260.

11.(*273*) Simon, S. W., and Emmons, W. H. Responses to material presented during various levels of sleep. *J. exp. Psychol.*, 1956, **51**, 89-97.

12.(*273*) Harlow, H. F. The formation of learning sets. *Psychol. Rev.*, 1949, **56**, 51-65.

13.(*274*) Grice, G. R. The relation of secondary reinforcement to delayed reward in visual discrimination learning. *J. exp. Psychol.*, 1948, **38**, 1-16; Perin, C. T. A quantitative investigation of the delay-of-reinforcement gradient. *J. exp. Psychol.*, 1943, **32**, 37-51.

14.(*274*) Doré, L. R., and Hilgard, E. R. Spaced practice and the maturation hypothesis. *J. Psychol.*, 1937, **4**, 245-259; Bumstead, A. P. Finding the best method for memorizing. *J. educ. Psychol.*, 1943, **34**, 110-114.

15.(*281*) Muenzinger, K. F. Motivation in learning: I. Electric shock for correct response in the visual discrimination habit. *J. comp. Psychol.*, 1934, **17**, 267-277; Tolman, E. C., Hall, C. S., and Bretnall, E. P. A disproof of the law of effect and a substitution of the laws of emphasis, motivation, and disruption. *J. exp. Psychol.*, 1932, **15**, 601-614.

16.(*281*) Estes, W. K. An experimental study of punishment. *Psychol. Monogr.*, 1944, **57**, No. 3.

17.(*286, 291*) Bugelski, B. R. *The psychology of learning.* New York: Holt, 1956.

18.(*287*) Verplanck, W. S. The control of the content of conversation: reinforcement of statements of opinion. *J. abnorm. soc. Psychol.*, 1955, **51**, 668-676.

19.(*288*) Jenkins, W. O., and Stanley, J. C. Partial reinforcement: a review and critique. *Psychol. Bull.*, 1950, **47**, 193-234.

20.(*292*) Guthrie, E. R. *The psychology of learning.* (Rev. Ed.) New York: Harper, 1952.

21.(*293*) Brogden, W. J. Sensory pre-conditioning. *J. exp. Psychol.*, 1939, **25**, 323-332.

22.(*293*) Köhler, W. *Gestalt psychology.* New York: Liveright, 1929; Lewin, K. *Principles of topological psychology.* New York: McGraw-Hill, 1936; Tolman, E. C. *Purposive behavior in animals and men.* New York: Appleton-Century-Crofts, 1932.

23.(*293*) Hull, C. L. *Principles of behavior.* New York: Appleton-Century-Crofts, 1943.

24.(*294*) Dollard, J., et al. *Frustration and aggression.* New Haven: Yale Univ. Press, 1939.

CHAPTER 11. THE USE OF LEARNED BEHAVIOR

1.(*300*) James, W. *Principles of psychology.* (Vol. 1.) New York: Holt, 1890.

2.(*303*) Burtt, H. E. An experimental study of early childhood memory: final report. *J. genet. Psychol.*, 1941, **58**, 435-439.

3.(*304*) Postman, L., and Rau, L. Retention as a function of the method of measurement. *Univ. Calif. Publ. Psychol.*, 1957, **8**, 217-270.

4.(*306*) Kelly, H. P. *A factor analysis of memory ability.* Unpublished doctoral dissertation, Princeton Univ., 1954.

5.(*307*) Underwood, B. J. Studies of distributed practice: XI. An attempt to resolve conflicting facts on retention of serial nonsense lists. *J. exp. Psychol.*, 1953, **45**, 355-359.

6.(*307*) Lester, O. P. Mental set in relation to retroactive inhibition. *J. exp. Psychol.*, 1932, **15**, 681-699.

7.(*307*) Levine, J. M., and Murphy, G. The learning and forgetting of controversial material. *J. abnorm. soc. Psychol.*, 1943, **38**, 507-517.

8.(*307*) Edwards, A. L. Political frames of reference as a factor influencing recognition. *J. abnorm. soc. Psychol.*, 1941, **36**, 34-50.

9.(*308*) Jenkins, J. G., and Dallenbach, K. M. Oblivescence during sleep and waking. *Amer. J. Psychol.*, 1924, **35**, 605-612.

10.(*308*) Newman, E. B. Forgetting of meaningful material during sleep and waking. *Amer. J. Psychol.*, 1939, **52**, 65-71.

11.(*308*) Minami, H., and Dallenbach, K. M. The effect of activity upon learning and retention in the cockroach, *Periplaneta americana. Amer. J. Psychol.*, 1946, **59**, 1-58.

12.(*309*) Houlahan, F. J. Immediacy of interpolation and amount of inhibition. *J. educ. Psychol.*, 1941, **32**, 37-44.

13.(*310*) Zeller, A. F. An experimental analogue of repression: II. The effect of individual failure and success on memory measured by relearning. *J. exp. Psychol.*, 1950, **40**, 411-422.

14.(*310*) Truax, C. B. The repression response to implied failure as a function of the Hysteria-Psychasthenia Index. *J. abnorm. soc. Psychol.*, 1957, **55**, 149-000.

15.(*311*) Hebb, D. O. *The organization of behavior.* New York: Wiley, 1949.

16.(*312*) Bartlett, F. C. *Remembering: a study in experimental and social psychology.* New York: Macmillan, 1932.

17.(*315*) Lashley, K. S. *Brain mechanisms and intelligence.* Chicago: Univ. of Chicago Press, 1929.

18.(*315*) Van Wagenen, W. P., and Herren, R. Y. Surgical division of commissural pathways in the corpus

callosum: relation to spread of an epileptic attack. *Arch. Neurol. Psychiat.*, 1940, **44**, 740-759.
19.*(316)* Lashley, K. S. Studies of cerebral function in learning: XIII. Apparent absence of transcortical association in maze learning. *J. comp. Neurol.*, 1944, **80**, 257-281.
20.*(316)* Jacobsen, C. F. Functions of the frontal association areas in primates. *Arch. Neurol. Psychiat.*, 1935, **33**, 558-569.
21.*(316)* Harlow, H. F., and Johnson, T. Problem solution by monkeys following bilateral removal of the prefrontal areas: III. Test of initiation of behavior. *J. exp. Psychol.*, 1943, **32**, 495-500.
22.*(317)* Penfield, W., and Rasmussen, T. *The cerebral cortex of man.* New York: Macmillan, 1950.
23.*(317)* Culler, E., and Mettler, F. A. Conditioned behavior in a decorticate dog. *J. comp. Psychol.*, 1934, **18**, 291-303.
24.*(317)* Delgado, J. M. R., Roberts, W. W., and Miller, N. E. Learning motivated by electrical stimulation of the brain. *Amer. J. Physiol.*, 1954, **179**, 587-593; Olds, J. Pleasure centers in the brain. *Sci. Amer.*, 1956, **195** (4), 105-116.

CHAPTER 12. THINKING
1.*(322)* Gentry, G., Kaplan, S. J., and Iscoe, I. *Studies in abstractive generalization: comparisons between various human age groups and monkeys on similar learning tasks.* USAF School of Aviation Medicine Report No. 55-83, 1956.
2.*(322)* Gentry, G., Kaplan, S. J., and Iscoe, I. *Studies in abstractive generalization: comparison between monkeys and children on tests of learning and transfer ability.* USAF School of Aviation Medicine Report No. 55-9, 1956.
3.*(323)* Köhler, W. *The mentality of apes.* New York: Harcourt, Brace, 1925.
4.*(323)* Harlow, H. F. The formation of learning sets. *Psychol. Rev.*, 1949, **56**, 51-65.
5.*(324)* Piaget, J. *Judgment and reasoning in the child.* New York: Harcourt, Brace, 1928.
6.*(327)* Grant, D. A., Jones, O. R., and Tallantis, B. The relative difficulty of the number, form, and color concepts of a Weigl-type problem. *J. exp. Psychol.*, 1949, **39**, 552-557.
7.*(327)* Chard, R. D. and Schwartz, B. D. A new modified concept formation test. *Amer. Psychol.*, 1947, **2**, 274-275.
8.*(327)* Schwartz, B. D. *Certain relations between verbalization and concept formation.* Unpublished doctoral dissertation, Princeton Univ., 1948.
9.*(329)* Max, L. W. An experimental study of the motor theory of consciousness: III. Action current responses in deaf-mutes during sleep, sensory stimulation, and dreams. *J. comp. Psychol.*, 1935, **19**, 469-486; Max, L. W. An experimental study of the motor theory of consciousness: IV. Action current responses in the deaf during awakening, kinesthetic imagery, and abstract thinking. *J. comp. Psychol.*, 1937, **24**, 301-344.
10.*(331)* Matthews, G. V. T. The sensory nature of bird navigation. In Wostenholme, G. E. W., and Millar, E. C. P. (Eds.) *Ciba foundation symposium on extrasensory perception.* Boston: Little, Brown, 1956. Pp. 156-164.
11.*(334)* Adamson, R. E. Functional fixedness as related to problem solving: a repetition of three experiments. *J. exp. Psychol.*, 1952, **44**, 288-291.
12.*(334)* Adamson, R. E., and Taylor, D. W. Functional fixedness as related to elapsed time and to set. *J. exp. Psychol.*, 1954, **47**, 122-126; Birch, H. G., and Rabinowitz, H. S. The negative effect of previous experience on productive thinking. *J. exp. Psychol.*, 1951, **41**, 121-125.
13.*(334)* Luchins, A. S. Mechanization in problem solving—the effect of *Einstellung*. *Psychol. Monogr.*, 1942, **54**, No. 6.
14.*(334)* Thistlethwaite, D. Attitude and structure as factors in the distortion of reasoning. *J. abnorm. soc. Psychol.*, 1950, **45**, 442-458.
15.*(342)* Newcomb, T. M. *Personality and social change.* New York: Dryden, 1943.
16.*(343)* Lewin, K. Group decision and social change. In Swanson, G. E., et al. (Eds.) *Readings in social psychology.* (Rev. Ed.) New York: Holt, 1952. Pp. 459-473.

CHAPTER 13. VERBAL BEHAVIOR
1.*(347)* Ruesch, J., and Kees, W. *Nonverbal communication.* Berkeley: Univ. of Calif. Press, 1956.
2.*(350, 352)* Stetson, R. H. *Motor phonetics: a study of speech movements in action.* Amsterdam: North-Holland Publ. Co., 1951.
3.*(351)* Dietze, D. The facilitating effect of words on discrimination and generalization. *J. exp. Psychol.*, 1955, **50**, 255-260.
4.*(358)* Egan, J. P. Articulation testing methods. *Laryngoscope*, 1948, **58**, 955-991.
5.*(360)* *Newsweek*, 1953, **41** (12), p. 56.
6.*(362)* McCarthy, D. Language development in children. In Carmichael, L. (Ed.) *Manual of child psychology.* (2nd Ed.) New York: Wiley, 1954. Pp. 492-630.
7.*(363)* Carroll, J. B. *The study of language.* Cambridge, Mass.: Harvard Univ. Press, 1953.
8.*(364)* Anderson, I. H. Studies in the eye movements of good and poor readers. *Psychol. Monogr.*, 1937, **48**, 1-35.
9.*(364)* Boder, D. P. The adjective-verb quotient: a contribution to the psychology of language. *Psychol. Rec.*, 1940, **3**, 310-343.
10.*(365)* Flesch, R. *The art of readable writing.* New York: Harper, 1949.
11.*(368)* Werner, H. Change of meaning; a study of

semantic processes through the experimental method. *J. gen. Psychol.*, 1954, **50**, 181-208.
12.(*369*) French, N. R., Carter, C. W., and Koenig, W. The words and sounds of telephone conversations. *Bell System Tech. J.*, 1930, **9**, 290-324.
13.(*371*) Razran, G. H. S. A quantitative study of meaning by a conditioned salivary technique (semantic conditioning). *Science*, 1939, **90**, 89-90.

CHAPTER 14. SOCIAL BEHAVIOR
1.(*378*) McClelland, D. C. *Personality*. New York: Sloane, 1951.
2.(*386*) Clark, K. B., and Clark, M. P. Racial identification and preference in Negro children. In Swanson, G. E., et al. (Eds.) *Readings in social psychology*. (Rev. Ed.) New York: Holt, 1952. Pp. 551-560.
3.(*388*) McKeachie, W. J. Individual conformity to attitudes of classroom groups. *J. abnorm. soc. Psychol.*, 1954, **49**, 282-289.
4.(*390*) Harlow, H. F. Social facilitation of feeding in the albino rat. *J. genet. Psychol.*, 1932, **41**, 211-221.
5.(*391*) Stouffer, S. A., and Toby, J. Role conflict and personality. *Amer. J. Sociol.*, 1951, **56**, 395-406.
6.(*393*) Eisenberg, P., and Lazersfeld, P. F. The psychological effects of unemployment. *Psychol. Bull.*, 1938, **35**, 358-390.
7.(*395*) Newcomb, T. M. *Social psychology*. New York: Dryden, 1950.
8.(*395*) French, J. R. P., Jr. Organized and unorganized groups under fear and frustration. *Univ. Iowa Stud. Child Welf.*, 1944, **20**, No. 409.
9.(*397*) Coch, L., and French, J. R. P., Jr. Overcoming resistance to change. *Human Relations*, 1948, **1**, 512-532.
10.(*398*) Gilchrist, J. C. Personal communication, 1957.
11.(*399*) Bales, R. F. How people interact in conferences. *Sci. Amer.*, 1955, **192** (3), 31-35.

CHAPTER 15. INDIVIDUAL DIFFERENCES
1.(*415*) Terman, L. M., and Oden, M. H. *Genetic studies of genius*. Vol. 4. *The gifted child grows up*. Stanford, Calif.: Stanford Univ. Press, 1947.
2.(*415*) Miles, C. C. Gifted children. In Carmichael, L. (Ed.) *Manual of child psychology*. (2nd Ed.) New York: Wiley, 1954. Pp. 984-1063.
3.(*416*) Burks, B. S. The relative influence of nature and nurture upon mental development: a comparative study of foster parent-foster child resemblance and true parent–true child resemblance. *Yearb. Nat. Soc. Stud. Educ.*, 1928, **27** (I), 219-316; Leahy, A. M. Nature-nurture and intelligence. *Genet. Psychol. Monogr.*, 1935, **17**, 236-308.
4.(*416*) Skodak, M., and Skeels, H. M. A follow-up study of children in adoptive homes. *J. genet. Psychol.*, 1945, **66**, 21-58.
5.(*416*) Freeman, F. N., Holzinger, K. J., and Mitchell, B. C. The influence of environment on the intelligence, school achievement, and conduct of foster children. *Yearb. Nat. Soc. Stud. Educ.*, 1928, **27** (I), 102-217.
6.(*417*) Klineberg, O. *Negro intelligence and selective migration*. New York: Columbia Univ. Press, 1935.
7.(*420*) Fleishman, E. A. *A summary of psychomotor test development research accomplished in the skill components research laboratory*. Lackland AFB, Tex.: Air Force Personnel and Training Research Center, 1955. (Unpublished draft.)
8.(*420*) Anastasi, A., and Foley, J. P. *Differential psychology*. (Rev. Ed.) New York: Macmillan, 1949.
9.(*422*) Stanton, H. M. The measurement of musical talent: the Eastman experiment. *Univ. Iowa Stud. Psychol. Music*, 1935, **2**.
10.(*422*) Ross, V. R. Relationships between intelligence, scholastic achievement, and musical talent. *J. juv. Res.*, 1936, **20**, 47-64.
11.(*422*) Meier, N. C. Factors in artistic aptitude: final summary of a ten-year study of a special ability. *Psychol. Monogr.*, 1939, **51**, No. 5.
12.(*422*) Paterson, D. G., Elliott, R. M., Anderson, L. D., Toops, H. A., and Heidbreder, E. *Minnesota mechanical ability tests*. Minneapolis: Univ. of Minn. Press, 1930.
13.(*425*) Wotruba, T. Personal communication, 1956.
14.(*425*) Wis. State Employment Service. Personal communication, 1957.

CHAPTER 16. PERSONALITY MEASUREMENT
1.(*428*) The term "personology" was introduced and used in a more general sense to describe the psychology of personality in Murray, H. A. *Explorations in personality*. New York: Oxford Univ. Press, 1938.
2.(*429*) Pascal, G. R. The analysis of handwriting: a test of significance. *Char. and Pers.*, 1943, **12**, 123-144.
3.(*430*) Page, H., Thurston, J., Nuthman, C., Calden, G., and Lorenz, T. An empirical study of the relationship of four classes of body habitus to responses on the MMPI. *Psychol. Reports*, 1955, **1**, 159-165.
4.(*430*) Fiske, D. W. A study of relationships to somatotype. *J. appl. Psychol.*, 1944, **28**, 504-519.
5.(*433*) Taylor, J. A. A personality scale of manifest anxiety. *J. abnorm. soc. Psychol.*, 1953, **48**, 285-290.
6.(*435*) Meehl, P. E., and Hathaway, S. R. The K factor as a suppressor variable in the MMPI. In Welsh, G. S., and Dahlstrom, W. G. (Eds.) *Basic readings on the MMPI in psychology and medicine*. Minneapolis: Univ. of Minn. Press, 1956. Pp. 12-40.
7.(*435*) McKinley, J. C., Hathaway, S. R., and Meehl, P. E. The K scale. In Welsh, G. S., and Dahlstrom, W. G. (Eds.) *Basic readings on the MMPI in psychology and medicine*. Minneapolis: Univ. of Minn. Press, 1956. Pp. 112-123.
8.(*436*) Hutt, M. L. The uses of projective methods of

measurement in Army medical installations. *J. clin. Psychol.*, 1945, **1**, 134-140.
9.(*437*) Blum, G. S., and Hunt, H. F. The validity of the Blacky pictures. *Psychol. Bull.*, 1952, **49**, 238-250.
10.(*439*) Tomkins, S. S., and Miner, J. B. *The Tomkins-Horn picture arrangement test.* New York: Springer, 1957.
11.(*439*) Tomkins, S. S., and Miner, J. B. Contributions to the standardization of the Tomkins-Horn PAT: plate norms. *J. Psychol.*, 1955, **39**, 199-214.
12.(*440*) Rogers, C. R. *Client-centered therapy.* Boston: Houghton Mifflin, 1951.
13.(*444*) Freeman, G. L., Manson, G. E., Kalzoff, E. T., and Pathman, J. H. The stress interview. *J. abnorm. soc. Psychol.*, 1942, **37**, 427-447.
14.(*444*) Wonderlic, E. F., and Stevens, S. N. *Diagnostic Interviewer's Guide.* Glencoe, Ill.: Wonderlic, 1937.
15.(*444*) Schmidt, H. O. Test profiles as a diagnostic aid. In Welsh, G. S., and Dahlstrom, W. G. (Eds.) *Basic readings on the MMPI in psychology and medicine.* Minneapolis: Univ. of Minn. Press, 1956. Pp. 351-362.
16.(*446*) Cattell, R. B. *Description and measurement of personality.* Yonkers: World Book Co., 1946; Thurstone, L. L. The factorial description of temperament. *Science,* 1950, **111**, 454-455.
17.(*446*) Freud, S. *An outline of psychoanalysis.* New York: Norton, 1949.
18.(*448*) Lewin, K. *A dynamic theory of personality.* New York: McGraw-Hill, 1935.
19.(*449*) Kuhlen, R. G. Age differences in personality during adult years. *Psychol. Bull.*, 1945, **42**, 333-358.

Chapter 17. The Behavior Disorders

1.(*462*) Jersild, A. T. Emotional development. In Carmichael, L. (Ed.) *Manual of child psychology.* (2nd Ed.) New York: Wiley, 1954. Pp. 833-917.
2.(*462*) Bernstein, A., Winick, C., Nyswander, M., Kaufer, G., and Brill, L. *The treatment of drug addicts as voluntary out-patients: a progress report.* New York: Narcotic Addiction Research Project, the New York Postgraduate Center for Psychotherapy, 1957.
3.(*465*) Brill, N. Q., and Beebe, G. W. Follow-up study of psychoneuroses; preliminary report. *Amer. J. Psychiat.*, 1951, **108**, 417-425.
4.(*468*) Meyer, A. *The commonsense psychiatry of Dr. Adolf Meyer.* (Ed. by A. Lief.) New York: McGraw-Hill, 1948.
5.(*469*) Rosen, J. N. *Direct analysis; selected papers.* New York: Grune and Stratton, 1953.
6.(*470*) Moreno, J. L. *Psychodrama.* New York: Beacon House, 1946.
7.(*472*) Barron, F. *Some test correlates of response to psychotherapy.* Berkeley, Calif.: Institute of Personality Assessment and Research, 1956.
8.(*473*) Auld, F., Jr., and Murray, E. J. Content-analysis studies of psychotherapy. *Psychol. Bull.*, 1955, **52**, 377-395.
9.(*475*) Stainbrook, E. Shock therapy: psychologic theory and research. *Psychol. Bull.*, 1946, **43**, 21-60.
10.(*475*) Zubin, J., and Barrera, S. E. Effect of electric convulsive therapy on memory. *Proc. Soc. exp. Biol., N. Y.*, 1941, **48**, 596-597.
11.(*475*) Barsa, J. A., and Kline, N. S. Combined reserpine-chlorpromazine therapy in disturbed psychotics. *A. M. A. Arch. Neur. Psychiat.*, 1955, **74**, 280-286.
12.(*475*) Mental patient data for fiscal year 1956. *Publ. Health Reports,* 1957, **72** (1), 14-15.
13.(*476*) Abramson, H. A., Jarvik, M. E., Kaufman M. R., Kornetsky, C., Levine, A., and Wagner, M. Lysergic acid diethylamide (LSD-25): I. Physiological and perceptual responses. *J. Psychol.*, 1955, **39**, 3-60.
14.(*478*) Rogers, C. R. *Client-centered therapy.* Boston: Houghton Mifflin, 1951.

Index